CHARLES UNIVERSITY IN PRAGUE
FACULTY OF PHYSICAL EDUCATION AND SPORT
DEPARTMENT OF PHYSIOTHERAPY

CASE STUDY FOR BACHELOR THESIS

CASE STUDY: PHYSIOTHERAPY TREATMENT OF A PATIENT WITH DIAGNOSIS OF DISC HERNIATION AND SPONDYLOLISTHESIS OF L5-S1.

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ABSTRACT

Case study: Physiotherapy treatment of a patient with diagnosis of disc herniation and spondylolisthesis of L5-S1.

Nazev: Fyzioterapie léčba pacienta s diagnózou herniace disku a spondylolistéza z L5-S1.
Author: Anastasia Krokou

Summary

In this case study I negotiate the topic mentioned above and I quote the two main approaches. The theoretical approach with a close aspection to the functional and structural mechanism of the spinal column, combined to the biomechanical and kinesiological approach, focused more on lumbar spine, and the pathological disturbances that may arise in this region, in this case it will be about disc herniation.

The other approach that completes my study work is the practical one and it concerns the application of rehabilitation and physiotherapy principles in order to treat the post-operative sequences that follow and how the treatment plan of short and long term of rehabilitation will look like. My bachelor's thesis practice took place in Ustředni Vojenská Nemocnice Praha during the period of 16.1-27.1 at the department of neurosurgery and also at the department of out coming patients. I used my knowledge that I gained these years while studying at Charles University at the department of Physiotherapy and applied for the best results according to the patients' situation.

My patient is a woman who suffered from chronic lumbalgia and two weeks ago after an overloading at lumbar region, a disc herniation occurred at the segments of L5-S1 (right side). Therapy lasted two weeks and included four sessions. Patient after the sessions has got improved in terms of better ROM in hip knee and ankle joint (mostly right one) in all the directions and also her walking pattern and coordination. Muscle balance and functional motor fashion in the proper way was the goal in her while being able to return to her ADL as well.

Key words: lumbar disc herniation, stress mechanism and loading, IVD, back pain, physiotherapy.

Shrnutí

V této případové studii jsem jednat téma bylo uvedeno výše, a cituji dva hlavní přístupy.Teoretický přístup s blízkým aspection na funkční a strukturální mechanismu páteře, v kombinaci s biomechanické a kineziologický přístup, zaměřený více na bederní páteři, a patologické poruchy, které mohou nastat v této oblasti, v tomto případě to bude asi herniace disku.

Druhý přístup, který dokončil svůj studijní práce je praktická a to se týká uplatňování rehabilitace a fyzioterapie principy, aby k léčbě pooperační sekvence, které se řídí a jak léčebný plán z krátkodobého i dlouhodobého hlediska rehabilitace bude vypadat. Moje bakalářská práce Praxe proběhla v Ústřední Vojenské Nemocnice Praha, v období 16.1-27.1 na oddělení neurochirurgie a také na katedře z následujících pacientů. Použil jsem své znalosti, které jsem získal tyto roky při studiu na Karlově univerzitě na katedře fyzioterapie a používají se pro dosažení nejlepších výsledků dle stavu pacientů.

Moje pacientka je žena, která trpěla chronickým lumbalgia a dva týdny po přetížení v bederní krajině, herniace disku došlo v segmentu L5-S1. Léčba trvala dva týdny a zahrnoval čtyři sezení. Pacient po zasedání má zlepšit ve smyslu lepšího ROM v hip kolenní a hlezenní klouby (většinou pravé) ve všech směrech a také její chůze vzor a koordinace. Svalová rovnováha a funkční módní motoru ve správném způsobem byl cíl v ní zároveň budou moci vrátit do své ADL také.

Klíčová slova: bederní herniace disku, stres mechanismus a zatížení, meziobratlových plotének, bolesti zad, fyzioterapie.

Autor: Anastasia Krokou

Praha, Česká republika

DECLARATION

I declare that this bachelor thesis is written and organized by myself having a great interaction and communication with my patient. Signed by me and all the therapeutic procedures were provided by me, according to the knowledge from the years of studying at Charles University in Prague.

There were no invasive methods used in Ustředni Vojenská Nemocnice during my clinical practice. Patient was fully informed about the examinations and therapy applied. An informative paper was signed by me and the patient.

My case study at Ustředni Vojenská Nemocnice was supervised by Mgr. Agnieszka Kaczmarská Ph.D and also from the department of Physiotherapy in Faculty of Physical Education and Sport, Charles University in Prague, by Mgr. Agnieszka Kaczmarská Ph.D as well.

According authority law

Anastasia Krokou

April, 2012

Prague, Czech Republic

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Also this work is dedicated to my parents and family for their great support and encouragement that they have been giving me all these years. A huge thanks to them as well and I am grateful for what they offered me.

DEDICATE

The decision to come and study in Prague was taken all of a sudden. A search in the internet revealed the home page of Charles University and the department of physiotherapy, which is categorized among the well known universities in the world. It stimulated my interest and as the time passed I was expecting it with even more intense.

Prague is one of the most fascinating capitals in Europe and I never regret for the choice that I made. This trip and the memories of the student life in Prague will always be my guide in life.

I cannot believe that time has passed so quickly. I even remember clearly when I first faced the faculty at my very first day in Prague. Amazing feeling that still accompanies me.

I met great people from different and I got to know them better through the years. Many memories have been locked in my heart and will be there forever.

I feel thankful for my teachers for sharing their knowledge with us and revealing the science and truth of how a respectful physiotherapist is look like. Despite the theory, behind this profession is hiding an honest relationship between the therapist and the patient and this is something unique.

Physiotherapist has to deal not only with the body from an anatomical, kinesiological and functional aspect but also from the point of a human being who has a soul and mental ability in combination with the above and interacting as a whole system and model. Then he/she will be successful in this profession.

CONTENTS

1.

INTRODUCTION

(PREFACE)

1. Introduction (Preface)

In this bachelor thesis work the mechanism of injury of lumbar disc herniation is described and analyzed in details. Anatomy of the lumbar region, biomechanical and kinesiological views is elaborated in the theoretical section. Also includes etiology of the disease, pathogenesis, examination from physician and physiotherapist and aspection of the clinical picture (signs & symptoms), treatment (surgical and non-surgical), surgical treatment (post-operative approach), and physical therapy.

In the practical part (case study) there is a completely analysis of the state of my patient: present state, anamnesis, previous rehabilitation, differential diagnosis, indication for rehabilitation, initial examinations, conclusion, therapy proposals, short term and long term rehabilitation plans, day to day procedures, therapy results, self-therapy instructions, final kinesiologic examination and conclusion of the progress of the therapy.

In this bachelor thesis I tried to deliver to the reader a clear view from anatomical, biomechanical and kinesiological aspects how the state of a lumbar disc herniation is and how the mechanical and structural changes along the spine can lead to this functional damage.

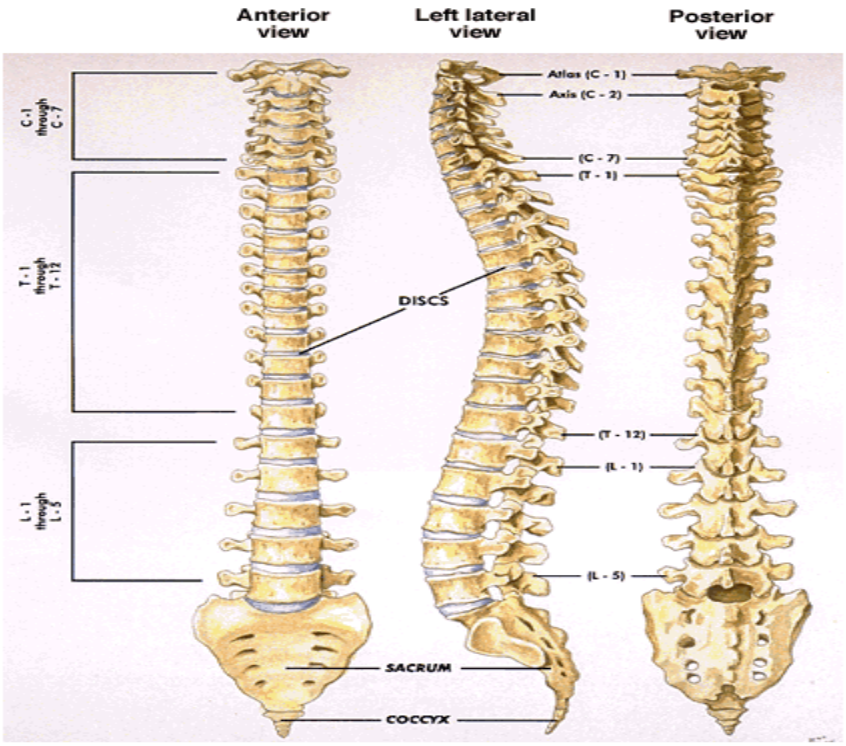
2.

GENERAL PART

2.1 VERTEBRAL COLUMN IN GENERAL

Our vertebral column also found and referred to as backbone or spine in literature. Inside the spinal canal, the spinal cord is located, kept safely and protected from injuries. Its features are that is a flexible, curved, vertical column, and consists of a rod with 33 (thirty three) movable articulated links called **vertebrae**. [13]

Spine can be subdivided into cervical, thoracic, lumbar spine and the two fused structures, sacrum and coccyx. Cervical spine is composed of 7 (seven) vertebrae, thoracic spine is longer with 12 (twelve) vertebrae and lumbar spine consists of 5 (five) vertebrae. We can also distinguish the 5 (five) fused vertebrae of sacral bone and 4 (four) vertebrae of the coccyx. [15]

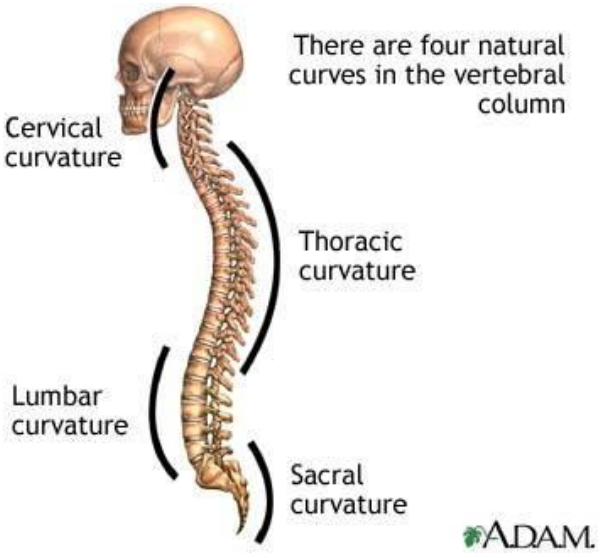


Picture 1. Anatomy of the spine. [30]

The vertebrae are strongly held together by ligaments which prevent any dislocation or injury, but allow on the other hand a range of movement, which provides to our spine the mobility and flexibility for our locomotor demands. [15]

The adult vertebral column is approximately 60-70 (sixty-seventy) cm in length. [14]

From the side, we can observe three curves of the spine. The neck, or else the *cervical spine*, curves slightly inward. The thoracic spine curves outward. The low back, called the *lumbar spine*, curves slightly inward. An inward curve in the spine is called *lordosis* and an outward curve, is called *kyphosis*. The kyphosis is shaped like a "C" with the opening in front. In cases of muscle disbalances and core instability we can see exaggerated positions of the spine with hyper kyphosis and hyperlordosis. [14]



Picture 2. The curves of the spine. [31]

The spinal curves provide support, flexibility, stability and the needed stiffness of the spine. They distribute the vertical pressure on the spine, and bear the weight of the body. If the spine was absolutely straight, it would be more likely to collapse under the pressure of the weight of the body. [14]

2.1.1 Overview of the functional aspects of the vertebral column

Backbone works as one unit with and undertakes the following vital functions:

- It acts as the axial support to the body and for our upright position.
- It strengthens the neck and the trunk for a more straight posture during standing and walking pattern.
- It supports the ribs laterally, holds the weight of the arms through the ribs and rests on the hip bone which transfers the weight of the body to the legs.
- Spinal canal safely surrounds and protects the spinal cord.
- It forms a rigid vertical column from which viscera are suspended by mesenteries in the body cavity.
- It allows flexibility to the trunk by having articular surfaces and intervertebral discs.
- The upper cervical vertebrae accomplish free movement of the head in all planes.(C0-C1, C1-C2) [7]

Each area of the spine has some differences in the shape and function of vertebral bodies and how they are attached to adjacent structures. [18]

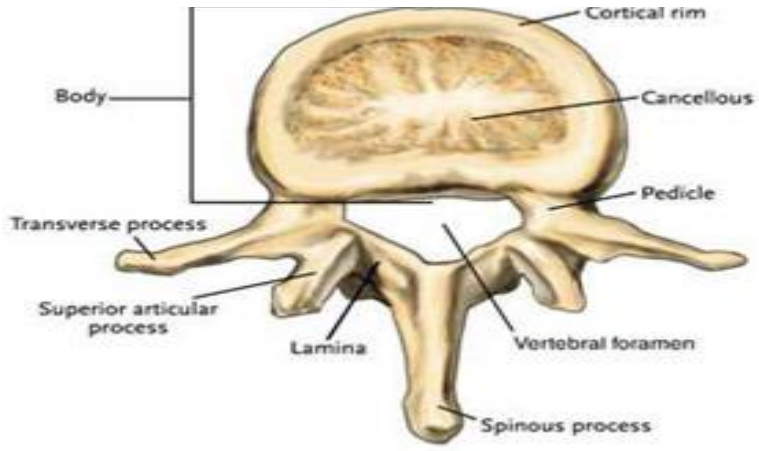
Therefore contributing to the differentiation of segmental motoric function and range of the movement. [18]

2.2 ANATOMY OF THE LUMBAR SPINE (& Sacrum)

From anatomical point of view there can be distinguished axial skeleton and skeleton of limbs. The axial skeleton consists of spine, skeleton of chest and skeleton of head. (os occipitalis). [11]

2.2.1 Vertebral Bodies in the Lumbar Spine (Lower Back)

The word “Lumbar” comes from the Latin word “lumbus,” which means lion, and the lumbar spine deserves its name. It is constructured for both power and providing flexibility (flexion, extension etc). The lumbar spine can be subdivided in structural characteristics: [2]



Picture 3. Parts of the lumbar vertebrae. [32]

The lumbar spine consists of 5 (five) vertebral bodies that extend from the lower thoracic spine (upper back) to the sacrum (bottom of the spine). The five vertebrae of the lumbar spine (L1-L5) are the biggest unfused vertebrae in the spinal column, enabling them to support the weight of the entire torso. [3]

The lumbar vertebrae increase in size from L1 till L5. These vertebrae bear much of the body's weight and undergo biomechanical stress. The pedicles are longer and wider than those in the thoracic spine. The spinous processes are horizontal and more squared in shape. The intervertebral foramens (neural passageways) are relatively large but nerve root compression is more common than in the thoracic spine. [3]

The lumbar spine is adjusted to the sacrum at the lumbosacral joint (L5-S1). This joint permits considerable rotation, so that the pelvis and hips can swing during walking and running. [9]

The lumbar spine's lowest two spinal segments, L4- L5 and L5-S1, which include the vertebrae and discs, bear the most weight and are therefore the most vulnerable to degradation and injury. [3]

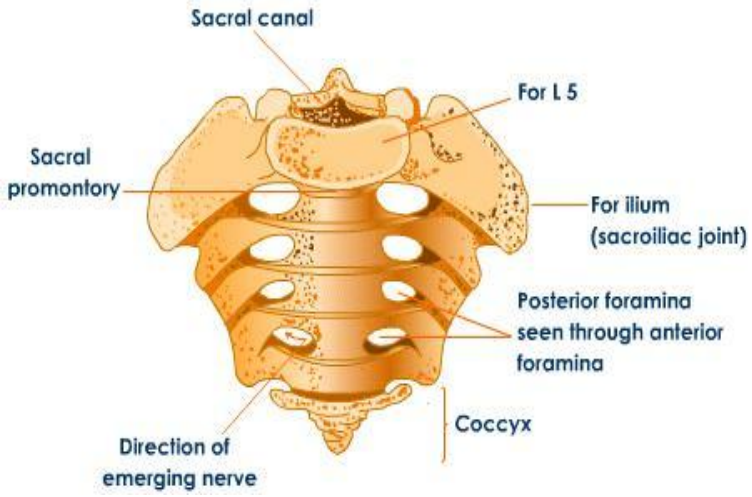
The paired facet joints on the back of the vertebral segments are aligned so that they allow flexion/extension but not a lot of rotation. [9]

2.2.2 The sacral bone (bottom of the spine)

Below the lumbar spine is a bone called the sacrum, which makes up the back part of the pelvis. The word sacrum in Latin means the sacral bone. This bone is shaped like a triangle that fits between the two halves of the pelvis, connecting the spine to the lower half of the body. [1]

It meets superiorly the lowest lumbar vertebrae (L5) and forms the lumbosacral junction which permits rotatory movements vital for walking. [1]

The sacrum is connected to part of the pelvis (the iliac bones) by the sacroiliac joints. [8]



Picture 4. Anatomy of the sacral bone. [33]

2.2.3 Joints of the lumbar spine

Intervertebral joints

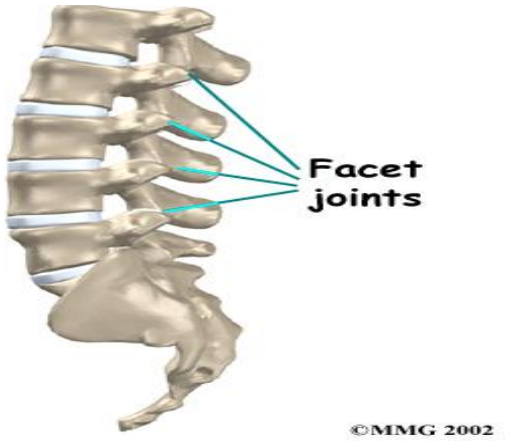
The intervertebral joint is called the space that is located between any two adjacent vertebrae. This space permits movement to occur in the spine. The meeting points of the two spinal bones involved in forming an intervertebral joint are the vertebral body (the front portion) and the vertebral arch (the back portion).[13]

Facet Joints or Zygapophysial joints

These are joints between the bones in our spine that allow performing motion such as bending backward (extension) and forward (flexion) and twisting and turning. The ***facet joints*** are specific joints between each vertebral body that helps with twisting motions and rotation of the spine. The facet joints are part of the posterior elements of each vertebra. Each vertebra has facet joints that connect it with the vertebrae superiorly and the vertebrae inferiorly in the spinal column. [10]

The surfaces of the facet joints are covered with a smooth ***articular cartilage*** that helps these parts of the vertebral bodies move smoothly against each other. [11]

They are non-axial, performing small gliding movements to. It is the junction between the ***inferior articular facet*** of the vertebrae above and the ***superior articular facet*** of the below vertebrae. The shape and orientation of the lumbar facets varies, influencing therefore the direction and range of movement of a motion segment and they oriented obliquely to prevent intervertebral rotation. [10]



Picture 5. Location of the facet joints. [34]

Lumbosacral joint

The lumbosacral joint is a joint of the body, between the last lumbar vertebra and the first sacral segment of the spinal cord and bears most of the human body and stress. [9]

Sacroiliac joint

The sacroiliac joint or SI joint is the joint in the bony pelvis between the sacrum and the ilium of the pelvis, which are joined by strong ligaments. The joint is a strong, weight bearing synovial joint with irregular elevations and depressions that produce interlocking of the two bones. The human body has two sacroiliac joints, one on the left and one on the right that often match each other but are highly variable from person to person. [12]

Intra-articular structures

Three types of intra-articular structures have been identified and are known as meniscoid structures. [10]

The first one are called ***fibroadipose meniscoids*** and are the largest meniscoid structures, which project from the inner surfaces of the superior and inferior capsules. [10]

They are shaped as leaf-like folds of synovial which enclose fat, collagen and blood vessels. The second one are the ***adipose tissue fat***, found at the superior and inferior ends of the joint, enclosing fat and blood vessels. The last one is called the ***connective tissue rim***, and is the smallest structure. It is a wedge-shaped thickening of the internal surface of the capsule. It can increase its surface of contact when the articular facets are impacted, therefore transmitting some loads. [10]

2.2.4 Ligaments- Connective Tissues

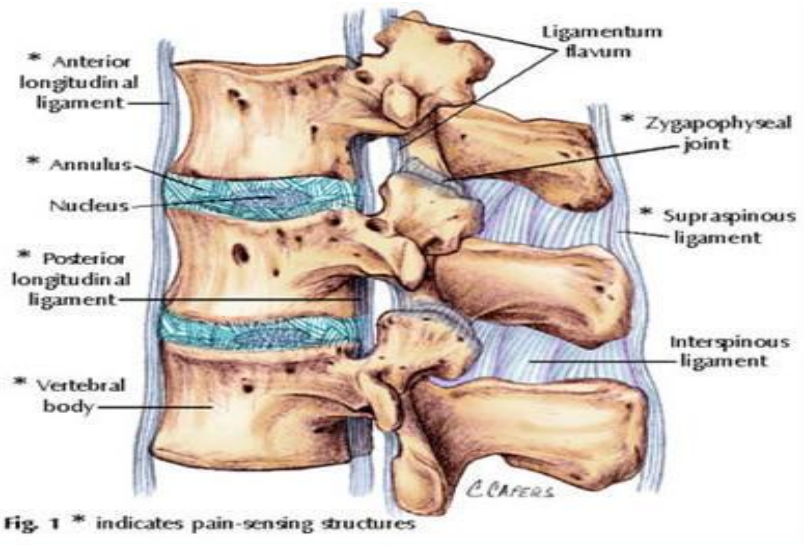
Connective tissues are patterns of fibers that keep the cells of the body together. *Ligaments* are strong connective tissues that connect and attach bones to other bones. Several long ligaments connect on the front and back sections of the vertebrae. The ***anterior longitudinal ligament*** runs along the spine on the front of the vertebral bodies and prevents hyperextension of the spine. Two other ligaments run full length within the spinal canal. The ***posterior longitudinal ligament*** attaches on the back of the vertebral bodies. [8]

The ***ligamentum flavum*** is a long elastic band that connects to the front surface of the lamina bones. Thick ligaments also connect the ribs to the transverse processes of the thoracic spine. [8]

The term "flavum" describes the yellow appearance of this ligament in its physiological state. The ligamentum flavum serves to protect the neural elements and the spinal cord and stabilize the spine so that excessive motion between the vertebral bodies does not occur. It is the strongest of the spinal ligaments and often has a thinner middle section. Together with the laminae, it composes the posterior wall of the spinal canal. [14]

Interspinous & supraspinous ligaments

Another ligament we can refer to is ***supraspinous ligament***, which joins the tips of the spinous processes and ends between L4-L5 and prevents hyperflexion. The ***interspinous*** and supraspinous ligaments resist separation of the spinous process during flexion of the spine, but they do not come into play until about half full flexion. [12]



Picture 6. Ligaments of lumbar spine. [35]

So they are slack at small angles of flexion and they are under tension for a few degrees but, as they are relatively weak, they are the first to be sprained immediately when the limit of flexion is reached. [12]

Intertransverse ligaments

They connect adjacent transverse processes, and they separate the anterior lumbar muscles from the posterior lumbar musculature. Their collagen fibers are not as densely packed or as regularly oriented unlike other ligaments of lumbar. It can be divided into the lateral portion (anterior and posterior layers), medial and inferior. [10]

Transforaminal ligaments

Bands of fibers that cross the outer end of the intervertebral foramen. They may decrease the space available for the emerging spinal nerve. It is divided in five bands: ***superior & inferior corpotransverse ligament, superior & mid- transforaminal ligament.*** [10]

Mamillo-accessory ligament

It is attached to the tips of the ipsilateral mamillary and accessory processes**.** [10]

Iliolumbar ligament

Connects the transverse process of L5 to ilium. They occur bilaterally and are only present in adults. Five parts compose it. First one called anterior & posterior iliolumbar ligament, inferior and superior iliolumbar ligament and the last one vertical iliolumbar ligament. It provides stability at the lumbosacral junction, preventing the fifth vertebrae from being displaced forwards. [8]

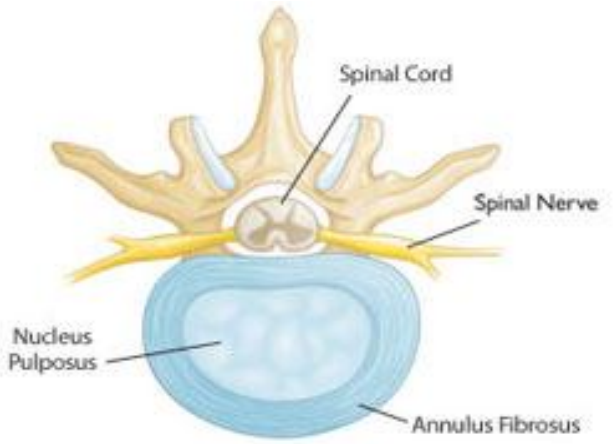
Intervertebral disc

A special type of structure in the spine called an ***intervertebral disc*** is also made of connective tissue. A gell-like pad whose fibers are formed by special cells, called *collagen cells.* The fibers may be lined up like strands of nylon rope or crisscrossed like a net. [8]

Intervertebral discs make up about one-third of the length of the spine and build the largest organ in the body without its own blood supply. The discs receive their blood supply through movement as they receive nutrients. [9]

Intervertebral discs are flat and round, and about a half inch thick. They separate the vertebrae, but they act as shock absorbers for the spine. They compress when weight is put on them and spring back when the weight is removed. [9]

They are made up of two components:



Picture 7.Healthy intervertebral disc. (Cross-section view). [36]

- ***Annulus fibrosus*.** The tough, flexible outer ring of the disc.
- ***Nucleus pulposus*.** The soft, jelly-like center of the disc. [15]

2.2.5 Nerves

The lumbosacral plexus extends from 11th thoracic vertebrae through SI segments of the spinal cord, inferior to which the cord continues to diminish as the conus medullaris. The anterior rami of the spinal nerves arising from this enlargement make up the lumbar (iliohypogastric, ilioinguinal, genitofemoral, lateral cutaneus femoral, femoral and obturator nerve) and sacral plexus (gluteal, sciatic, tibial, common fibular nerve) that innervate the lower limbs. [10]

Each joint is innervated from a dorsal ramus of a spinal nerve and two medial branches of adjacent **dorsal rami.** [10]

Meningeal branches of spinal nerves supply most bone, intervertebral discs, ligaments and as well as the meninges (coverings) of the spinal cord. These two groups of nerves convey all localised pain from the vertebral column. [1]

2.2.6 Fasciae & Muscles

Fasciae

The Lumbodorsal Fascia or Thoracolumbar Fascia. The lumbodorsal fascia is a deep investing membrane which covers the deep muscles of the back of the trunk. *Above,* it passes in front of the serratus posterior superior mm. and is continuous with a similar investing layer on the back of the neck-the **nuchal fascia.** [3]

In the lumbar region the fascia (*lumbar aponeurosis*) is in two layers, anterior and posterior. [3]

Muscles

The muscles of the lumbar spine contribute to flexion and extension of the lower back. They play a key role in postural support and stability. [13]

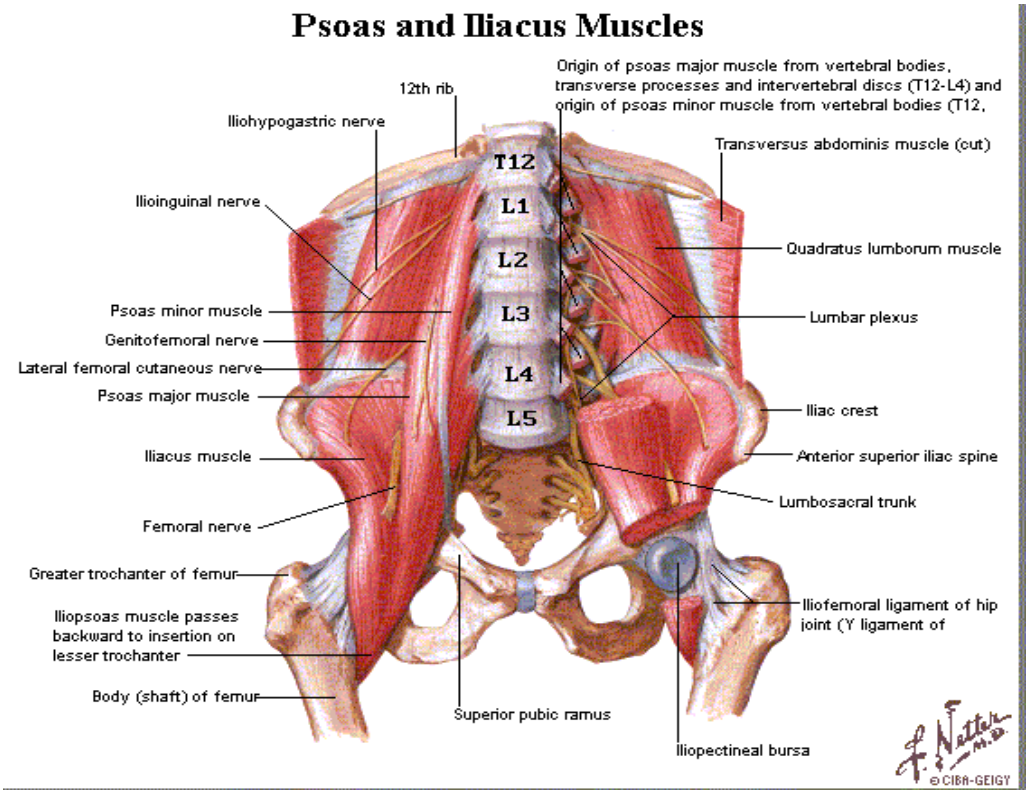
There are two major groups of muscles in the back. The ***extrinsic back muscles*** include superficial (trapezious, latissimus dorsi, levator scapulae, rhomboids mm.) and intermediate muscles (serratus posterior mm.) that produce and control limb and respiratory movements. The ***intrinsic (deep) back muscles*** include muscles that act on the vertebral column, producing its movements and maintaining posture. [8]

Principal muscles that produce movements of the whole trunk and lumbar intervertebral joints.

- **FLEXION:** Bilateral action of rectus abdominis, psoas major mm. and gravity force. [8]
- **EXTENSION:** Bilateral action of erector spinae, multifidus, semispinalis thoracis* and gluteus maximus mm. [8]
- **LATERAL FLEXION:** Unilateral action of iliocostalis thoracis* and lumborum, longissimus thoracis*, multifidus, external & internal oblique, quadratus lumborum, rhomboids, serratus anterior, SCM*, splenius*, gluteus medius & maximus*, adductor longus * mm. [8]

- **ROTATION:** Unilateral action of rotators, multifidus, iliocostalis, longissimus, external & internal oblique, splenious thoracis & cervicis*, transversospinalis* mm.[8]

*Involved in overall movement, but do not produce movement at lumbar IV joints. [8]



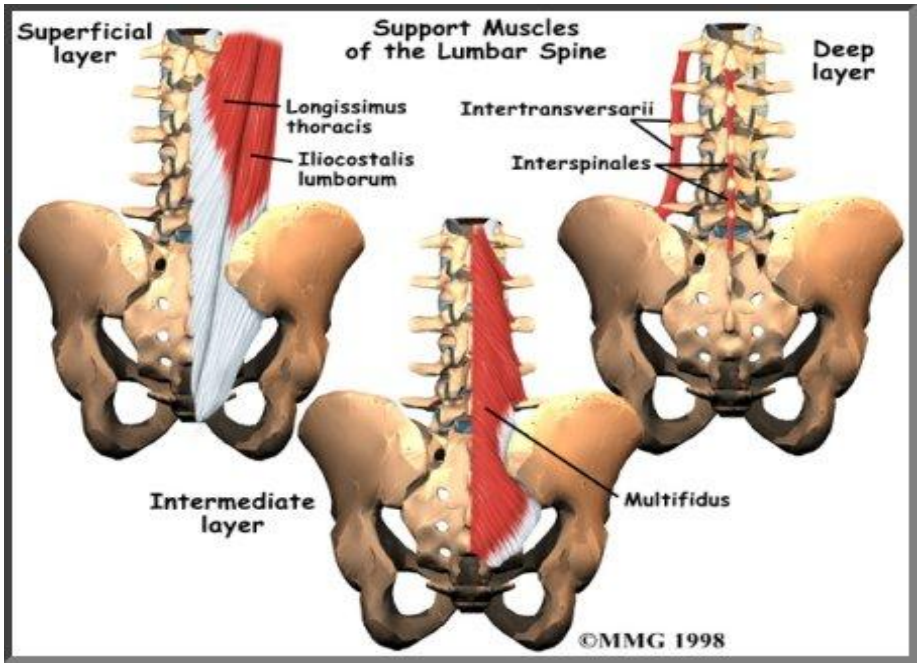
Picture 8. Iliacus and Psoas muscles. [37]

Intrinsic-Deep muscles of the back

SUPERFICIAL LAYER: Longissimus dorsi, Iliocostalis dorsi/lumborum, Spinalis dorsi mm. [1]

DEEP LAYER (TRASVERSOSPINALIS GROUP): Multifidus, Rotatores mm. [1]

MINOR DEEP LAYER: Interspinales, Intertrasversarii mm. (anteriores, mediales, posteriores, laterales) [1]



Picture 9. Deep muscles of the lumbar spine. [38]

MIDDLE LAYER OF THE BACK: Long and broad serratus posterior inferior mm. [8]

UPPER LAYER: Very long and strong muscle, latissimus dorsi. These middle and upper muscles works as erector spinae and often overload the short intersegmental muscles and provoke the lower back pains if too intensively activated. [8]

LATERAL GROUP: Muscle quadrates lumborum and muscle iliopsoas. Iliopsoas muscle has two distinct parts (iliacus and psoas m.) and accentuates the lumbar lordosis. Unilateral activity causes ipsilateral flexion of the trunk with slight contra-lateral rotation. Bilateral activity causes flexion of the femur against the pelvis. In upright standing it protects the fall of the body backward. Quadratus lumborum muscle is a complicated muscle connecting the last rib with the crest of iliac bone, the transverse process of lumbar vertebrae with iliac bone and the last vertebrae with the transverse processes of lumbar vertebrae. [8]

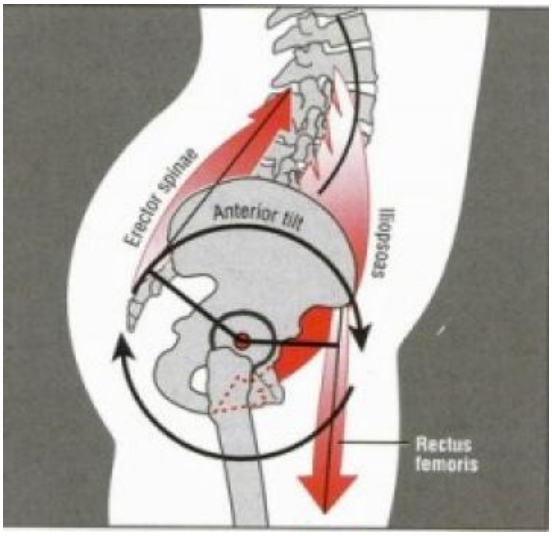
VENTRAL GROUP: Abdominal muscles. M. rectus abdominis, m. transversus abdominis, mm. oblique internus and externus along with diaphragm compromise the ventral group of muscles, responsible not only for breathing but also for postural function.[8]

Position of the pelvis and muscles involved.

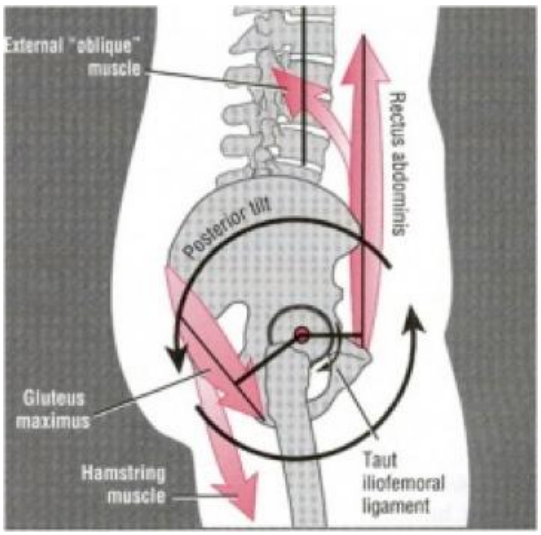
In lateral view, the anterior and posterior muscles attached to the pelvis maintain it in ideal alignment. [5]

Anteriorly, the abdominal muscles pull upward, and the hip flexors pull downward. Posteriorly, the back muscles pull upward, and the hip extensors pull downward. [5]

Thus, the anterior abdominal and hip extensor muscles work together to tilt the pelvis posteriorly the low back and hip flexor muscles work together to tilt the pelvis anteriorly. [5]



Picture 10. Anterior tilt of pelvis. [39]



Picture 11. Posterior tilt of pelvis. [40]

2.3 Low back & whole spine Biomechanics

From biomechanical point of view the spine is a curved, segmented, narrow and cylinder that consists of number of components with diverse rheological properties and whose aim is to keep flexibility and firmness. [11]

It is a very unstable system organized in such a way that in every moment it balances position that a collapse does not occur. [11]

An imbalance may begin with abdominal muscle weakness (or strain, obesity, pregnancy and childbearing in women) and tightness of the back muscles. Position of pelvis plays a key role as well.(anterior, posterior and lateral tilt). [5]

The problems of lower extremity pain (propagated pain) are those associated with a tight or stretched TFL muscle and ITB with sciatic pain accompanied with disc protrusion. Leading to pain in the region of posterior gluteus medius muscle and with knee and foot problems in which faulty alignment and muscle imbalance are important factors. [5]

In standing position, the least use of energy occurs when the vertical line of gravity falls through an inert supporting column of bones. As soon as the center of mass of a segment moves out of line with the supporting joint, a moment is established. The further the segment's line of gravity moves away from the joint, the greater a moment becomes. To retain in equilibrium, a force must be exerted to create a moment equal in magnitude and opposite direction.[6]

In erect position, with erector spinae and abdominal muscles relaxed, the lumbosacral joint undertakes only the weight of the body. Enormous low back strain may be involved in forward flexion of the trunk. The dangerous compressive forces produced, act on the lumbar IVDs and increased shearing forces appear between the fifth lumbar vertebrae and the sacrum. [6]

In counterprise to this movement erector spinae is in action and passive structures (ligaments, Intervertebral joints etc) must bear the full load. [6]

Stiffness and stability of the axial system is given by the axial skeleton-bone compartments. The bone components include (pelvis, vertebrae, occipital bone) show a significant volume of stiffness. The only compressible structure is the IVD that behaves as a rubbish bushing and thus it provides flexibility. In the moment that the IVD shows a pathological change, the rheological properties change. It is just the stiffness that provides stabilization process that is supported by continuous co-ordination of muscles providing perpetual adjustability of the whole axial system. [11]

2.3.1 Effects of Movements on the Intervertebral Disc

Movements in the IV joints occur in accompany of with those in the other joints in the motion segments and can never be isolated for them, and it includes the apophyseal joints. Combined movements occur more frequently than pure movements.[10]

FLEXION

During flexion, the anterior annular fibers are compressed and tend to bulge, while the posterior fibers are under tensile stress. During flexion the posterior annulus is stretched and thinned, so that the distance between the nucleus and outer annular fibers is decreased and the nucleus was relatively closer to the posterior margin of the disc. In life, when flexion of the spine occurs, it is often accompanied by muscular activity, depending on the starting position of the movement. Through its compressive effect this increases the intradiscal pressure. More compression and stress is added in repeatedly flexion of the spine. The movement of the nucleus has been of particular interest because of a number of disc herniation of the nucleus.[10]

EXTENSION

During this movement the posterior annulus is compressed and bulges, the anterior annulus is stretched and there is a tendency for the nucleus to deform forwards. Intradiscal pressure is lower than in flexion, but the effect of muscular activity must also be taken into account. [10]

LATERAL FLEXION

During the movement of lateral flexion, the annular fibers are compressed and tend to bulge on the side to which it occurs, while those in the opposite side have their attachments separated. There is some deformation of the nucleus in a similar manner to that which occurs in flexion- deformation on the compressed side and a tendency to move towards the opposite side. Intradiscal pressure also increases. [10]

SLIDING

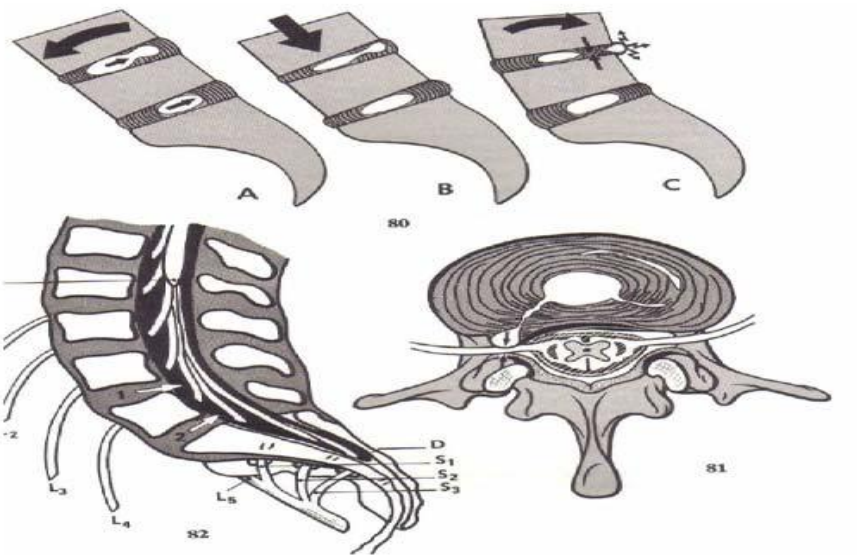
A small degree of sliding (1-2mm) occurs at the IV joints as an assistive movement during flexion, extension and lateral flexion. In flexion, forward sliding occurs and is resisted by the apophyseal joints and the annular fibers. The anterior and posterior fibers offer relatively less resistance to forward sliding, due to their orientation. [10]

ROTATION

Half of the annular fibers lie in the direction of rotation, while the other half lie in the opposite direction. So during rotation to one side, only half of the annular fibers have their points attached and the higher collagen concentration in the outer lamellae provide additional tensile strength. The inner fibers are the most oblique and during rotation they compress the nucleus, raising the intradiscal pressure. [10]

DISTRACTION

It can occur if a person is hanging by the arms or during some therapeutic traction technique. During distraction, every annular fiber has its points attachment separated, disc height increases and intradiscal pressure decreases. [10]

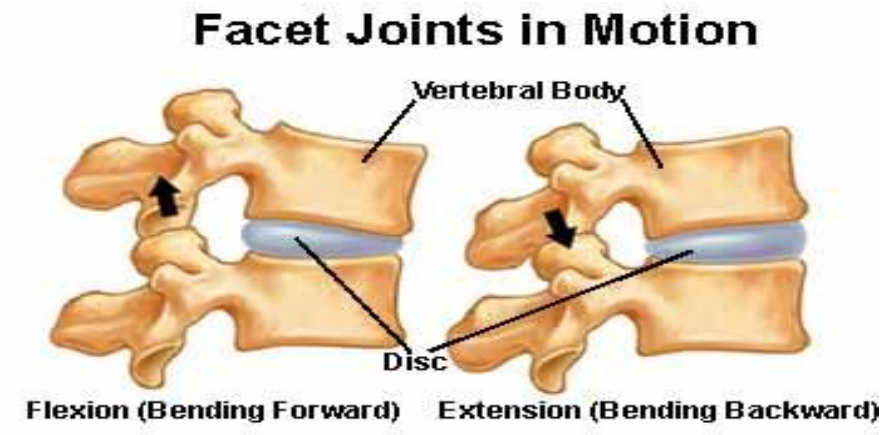


Picture 12. Lumbar disc herniation phases during motion (A-Flexion, C-Extension) and loading (B). [41]

2.3.2 Mechanical properties of healthy and degenerated IVD

The motion in the lumbar spine is divided between five motion segments, although a disproportionate amount of the motion is in the lower segments (L3-L4 and L4-L5). The two lowest discs (L4-L5 and L5-S1) take the most strain and are the most likely to herniate. This can cause lower back pain and possibly numbness that radiates through the leg and down to the foot (sciatica). [1]

A stress in the vertebral column is transmitted mostly to the end plates. The healthy IVD behaves as a car tire. The IVD is the main and determining element of force transmission between vertebrae and the main element of movement. Compressing adjacent vertebrae causes increasing of intradiscal pressure within the nucleus pulposus which stretches around the fibers of the annulus fibrosus. It means that the fibers of the annulus fibrosus are under a tension stress and prevent a prolapse of gel nucleus pulposus outside the IVD. So that the nucleus pulposus and the end plates above and below the nucleus pulposus are the pressure holders inside the IVD. [4]



Picture 13. Facet joints & IVD in motion (Flexion & Extension). [42]

The biggest share of tension stress is carried by so called Sharpeys' fibers. In case of unchanged discs the stress is transmitted from center of the end plate but in degenerative state the stress is transmitted more peripherally. A degenerative IVD loses its viscous properties, becomes more rigid and ceases to be an ideal gel infilling.[11]

This is being explained by loss of the nucleus pulposus hydration that accompanies degeneration. It was shown that the spinal flexibility, ROM, is reduced in case of degeneration because of increasing size of the end plates and decreasing height of the disc interspace. There is increased laxity of motion segment due to reduction of interspace height which results into loss of tension of the surrounding ligament. When intradiscal pressure was increased, degenerated disc herniated at lower pressure in comparison to a normal disc. [11]

The IVD height decrease causes adverse redistribution of the stress. Findings showed that a healthy IVD carries about 80% of the total load intervertebral joints. The decrease of the IVD due to ageing (degeneration) may reverse this ratio. Highly innervated joint processes may therefore become a significant generator of pain.[4]

A degenerated IVD has larger passive zone resulting in greater slackness between adjacent vertebrae in the sense of horizontal displacements. Translations become more dominant against rotation. [4]

Important to mention as well is that lack of substances transport from and to the IVD is considered to be a major cause of its degenerative changes. The IVDs are the largest areas in the human body without its own vascular supply. So all solute transport is provided by diffusion from neighboring rich vascularized vertebral bodies or surrounding soft tissues. [11]

The end plate plays a role not only for the exchange of substances between bloodstream and the IVD but it also influences the viscoelastic properties of IVD as a whole. Shock absorption is guaranteed not only by the viscoelastic nature of IVD but partially by low flow liquids through the end plate against gradient of hydrostatic and osmotic pressure. Displacement of fluid from IVD during daily activities and its reinflation at night during sleeping is the most frequently used example. Transport in both directions occurs for example during walking due to dynamic loading. [9]

2.4 Kinesiology of the lumbar spine

The spine forms the axis of the body. It must be mobile and yielding as well as rigid and firm in selected sectors and must be able to adapt adequately to actual situations in the surrounding. Mobility of the spine is selected sectors must be compensated with fixation in adjoining. Axial rotation (a torsion movement) from the lumbar spine is 30˚. [15]

Mobility of the lumbar spine: Flexion of the whole spine in adults ranges between 40-60˚ and extension varies within 30-35˚. Flexion diminishes lumbar lordosis and extension increases it. [29]

Reduced mobility of one segment is compensated by increased mobility in the neighbor segment. The mobility of the spine can be reduced locally through the decrease of the range of movement in some segments. [29]

The spine as a whole reacts very early on postural changes earlier than the beginning of the imbalance is visible. [15]

The curves of the spine depend on the position of the pelvis. The backward tilt of the pelvis decreases the lumbar lordosis and influences the whole body bearing. The forward tilt increases the lumbar lordosis. The sideward tilt causes a compensatory scoliosis of the spine. The flattening of spinal curves increases the occupancy of discopathy. [5]

Very important role in the postural function plays the habitual posture. If this posture is kept repeatedly for long time such posture is fixed as a normally used holding pattern and becomes a coordinated posture even if causing problems. [5]

The transversospinal muscles in the deep layer of dorsal muscles realize torsion movements and mobilization of the spine and influence the position of local segments of spine (static and tonic muscles). The weakening of these muscles is the main cause of most spinal troubles. These deep small and weak muscles build the internal stabilization system realizing the stability of individual separate spinal segments. [29]

This deep system permeated by connective tissue has a tendency to shorten and causing different local restrictions of movement, and therefore affecting the gait. [29]

Smaller muscles generally have high number of muscle spindle concentration than do large muscles. This is why small muscles produce fine postural movements and for improving muscle balance we can influence this group of muscles. [1]

Often in chronic back strain (by excessive lumbar lordosis), in order to restore stability is important to eliminate the uneven distribution of weight and introduce exercises.[1]

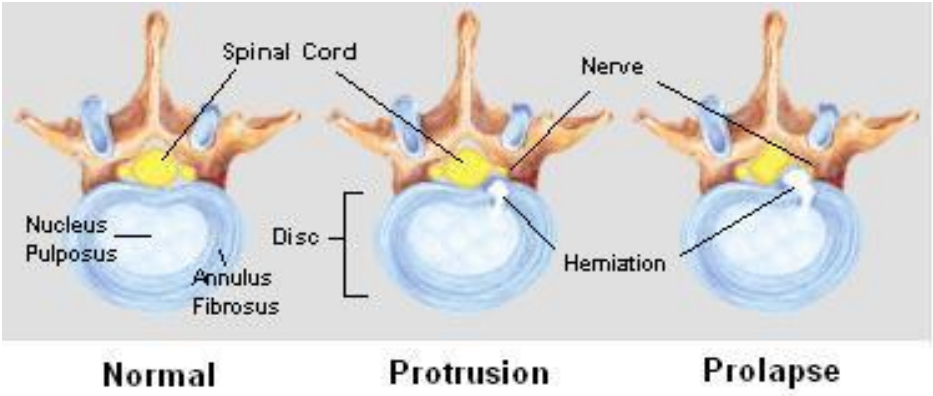
2.5DISC HERNIATION and SPONDYLOLISTHESIS

2.5.1 THE DISEASE

A herniated disk and spondylolisthesis are two potentially painful situations of the vertebral column, which contribute negatively on the stability and function of the spinal column. While herniation affects the discs between the spinal bones (vertebrae), spondylolisthesis affects the bones themselves. [1]

Herniated Disc

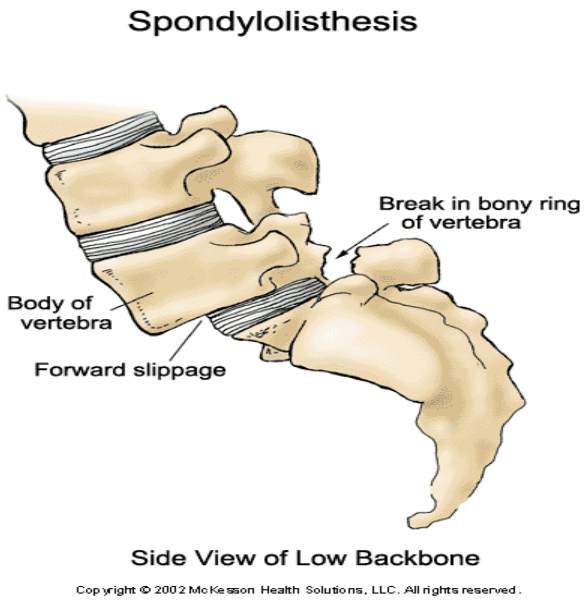
The disc herniation happens in the lumbar spine in two ways. The protruded fluid disc matter, nucleus pulposus, becomes fixed to the walls of the spinal canal and may heal here and pain may slowly disappear. Or the disc matter may freely move in the spinal canal as a foreign body irritating steadily the meninges and nerve roots, which are really painful. When the herniation is in the posterolateral direction the affected nerve root is the one that exits at level below the disk herniation. A foraminal herniation on the other hand affects the nerve root that is situated at the same level. There are four types of herniated disc: bulging, protrusion, prolapsed and sequestration. [10]



Picture 14. Lumbar disc herniation. [43]

Spondylolisthesis

This is described as the slanting down of the sacral bone causes the possibility of sliding down of the L5 vertebrae on the tilted sacral bone. The overloading may cause fracture of the vertebral arch. The last lumbar vertebrae is held in position only by ligaments, fibrous parts of inter vertebral disc and by intervertebral muscles. This state is associated with intensive pain. [8]



Picture 15. Spondylolisthesis schema (lateral view). [44]

2.5.2 ETIOLOGY

Low back pain is the most common type of pain. The causes of many painful conditions of the low back remain obscure. Low back pain bothers not only patients but also the experts about its multidisciplinary approaches. [5]

The typical background of a low back incidence is a faulty postural pattern. A mechanical or functional strain causing muscular disbalance in one part of the body may soon result in compensatory changes in other parts. Conversely, the symptoms appearing in the low back region may be caused by faulty mechanics of the feet, legs or hip. [5]

At the junction of L5/S1 apophyseal joint: the long mass of five fused vertebrae forming the sacrum articulate with the fifth lumbar vertebra and bear most of the weight and shearing forces and stress. [10]

In the standing position the lordotic curve of the lumbar spine places particular stress on the L5/S1 junction. With the wedge-shaped disc and body of L5, the tendency would be for L5 to slide forward on the sacrum. [10]

In the case of the most minor restrictions, we know from our own experience how these can happen: sitting or working for a long time in an unfavorable position, we sense a need to stretch and move, which is to ease such minor inhibitions of movement. Minor restrictions can be present even in physiological situations and in healthy individuals and these resolve spontaneously. There is a fluid transition between such minor restrictions following physiological stress, and persistent restrictions following physiological stress, and persistent restrictions following pathogenic, harmful stress.[7]

One pathogenic factor is overload and another one, more frequent is disturbed movement pattern (motor stereotype) on the part of the patient, consisting of an imbalance of muscle function, which impairs the joint. [7]

Modern civilization brings with it very one-sided pasture and movement causing muscular imbalance. Lack of movement together with static or postural overload are a characteristic feature of modern life. Disturbed movement patterns and static overload are probably the most frequent causes of reversible restrictions and of their occurrence and recurrence. [7]

This can lead to lack of muscle coordination, an indication for disturbance of body statics. “Flabby” posture is the expression of imbalance of the muscles of the pelvic girdle, it may be the result of weakened abdominal and gluteal muscles and hyperactive hip flexors. [5]

The curvature of the lumbar spine plays also a key role since it depends on the “type” of pelvis tilt. A flat spine goes hand in hand with hypermobility and lack of stability, while greater curvature corresponds to stability and less mobility. [7]

An intervertebral disc which works as a shock absorber and the element for transmission of forces between the vertebrae can be degenerated, consequently causing the disc protrusion. So it is highly linked with aging and also we can add obesity (general weight) and for women pregnancy and childbearing, which puts more loading on the lowest rings of lumbar spine. [9]

Among the risk factors are smoking (decreases oxygen transport to IVDs), improper lifting (more load on back and worse while twisting motion is present), repetitive activities that strain your spine (many jobs are physically demanding. Some require constant lifting, pulling, bending, or twisting), frequent driving (staying seated for long periods, plus the vibration from the car engine, can put pressure on your spine and discs). [11]

Degenerative changes can lead to disc herniation as a sequel. There is a close relationship between structural change and dysfunction. [11]

2.5.2 ETIOPATHOLOGY

The IVD in young persons are strong. Furthermore the water content of their nucleus pulposus is high giving them great turgor. Steadily along with aging the amount of water decreases and degenerative change begin to appear combined with disturbed motor pattern. However violent hyperflexion of the vertebral column may rupture an IVD and fracture the adjacent vertebral bodies. [11]

Additionally combination of axial pressure and shearing forces on the covering plates of lumbar vertebrae can lead to disc protrusion. [11]

This occurs particularly if a heavy burden is lifted from the bottom through erection position of the forward bent trunk with extended knees in combination to synchronous quick twist movement. This torsion produces shearing force added to existing axial pressure. These both forces together damage the disc. [11]

Flexion of the vertebral column produces compression anteriorly and stretching or tension posteriorly, squeezing the nucleus pulposus further posteriorly towards the thinnest part of the annulus fibrosus, the NP protrudes into the spinal canal and irritate the meninges and nerve roots. If the annulus fibrosus has degenerated, the NP may herniate into the vertebral canal and compress the spinal cord or the nerve roots of the cauda equina. [4]

A posterolateral herniated IVD is more likely to be symptomatic because of the proximity of the spinal nerve roots. The localized back pain of a herniated disc, which is usually acute pain, results from pressure on the longitudinal ligaments and periphery of the annulus fibrosus and from local inflammation caused by chemical irritation by substances from the ruptured nucleus pulposus. [4]

2.5.4 CLINICAL PICTURE

Radicular syndrome

It develops in the relevant skin segment innervated by the spinal nerve and relevant muscles get week and loose the muscle tone and get atrophic. It is present also loss of tactile sensibility accompanied by lower back pain caused by compression of the meninges in the spinal canal or in the intervertebral canal. [29]

Symptoms

Compression of lumbar nerves causes atrophies of following muscles:

Combined L5-S1: atrophy of m.extensor digitorum brevis, extensor hallucis brevis, mm. peronei and m. gastrocnemius but not tibialis anterior. [29]

Furthermore, symptoms include:

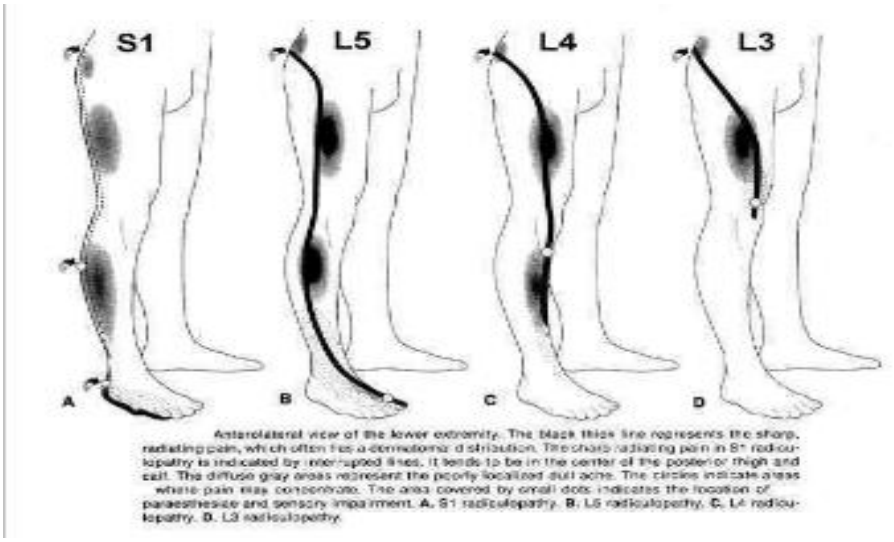
- Electric shock pain radiating down in posterior side of each leg from the buttocks to the knee or beyond.

- Numbness, tingling, weakness, or pain in the buttocks, back, legs, or feet.
- Numbness and tingling around the anus or genitals region.
- Pain with movement, sneezing, coughing, or when elevating legs.
- Difficulty controlling bowel movements or bladder function. [1]

Signs

With lower back herniations, patients typically experience and complaint sudden and severe pain which usually recedes without treatment and then gradually worsens over time. Often, in case of sciatic nerve, which carries impulses from the legs to the spine, is involved there is dull, burning pain in the back of the leg, sometimes extending all the way to the foot. Sitting, bending, sneezing, coughing - almost anything that can cause the disc to provide pressure on the nerve, will propagate pain. [1]

Also is present numbness and weakness of the lower extremities (usually on the posterior side of buttocks, thigh and calf till the foot) along with sensory deficits. Usually there is impairment in providing PF due to weakness of gastrocnemius. [1]



Anterolateral view of the lower extremity. The black thick line represents the sharp, radiating pain, which often has a dermatomal distribution. The sharp radiating pain in S1 radiculopathy is indicated by interrupted lines. It tends to be in the center of the posterior thigh and calf. The diffuse gray areas represent the poorly localized dull ache. The circles indicate areas where pain may concentrate. The area covered by small dots indicates the location of paraesthesias and sensory impairment. A, S1 radiculopathy. B, L5 radiculopathy. C, L4 radiculopathy. D, L3 radiculopathy.

Picture 16. L3-S1 radiculopathies according to the segment involved. [45]

2.5.5 Examination

2.5.5.1 Physician examination

To determine whether the patient suffers a herniated lumbar disc, the doctor will ask for a complete medical history, discussion about the symptoms and when they first started to occur, and how intense they are. He will also ask how the pain started- the mechanism of the injury and when it gets worst. Furthermore he will examine carefully the spine and conduct a complete physical examination. The diagnosis can be confirmed by a magnetic resonance imaging scan. This scan can create clear images of soft tissues like intervertebral discs. [8]

2.5.5.2 Physiotherapist's examination

Anamnesis – history

Physiotherapist asks from the patient to describe the mechanism of the injury in their own words and when it occurred. Even if the diagnosis is clear, the history will give important information about the problem. He or she will be interested in knowing when the first symptoms appeared and how, what kind of symptoms and in which scale, which movements worsen the pain and which alleviate it. Also whether his/her state engages his ADL and makes it more difficult for him and ergonomics. Ask about any occupational risks, recreational sports participation. [5]

Personal anamnesis also includes questions concerning chief complain (if pain is present, fever, hypertension etc), past rehabilitation, previous injuries and accidents, also previous surgeries, gynecological anamnesis (if she is a woman) if any complications with the menstrual cycle, allergies and abuses. Also physiotherapist asks about family history if there is any similar situation and past medical history that may give important information for the treatment plan and prognosis. [5]

Palpation and Muscle Tone examination, by Lewit

By palpation examination physiotherapist checks for any kind of edema in lumbar region and lower extremities, reflex changes in soft tissues of the back and lower extremities. [27]

For stage after microdiscectomy therapist is able to check the tone of the muscles, which includes quadriceps, adductors, tensor fasciae latae, iliopsoas, piriformis, gastrocnemius, hip extensors (gluteal mm.), back muscles (erector spinae mm.) and abdominal muscles and check for presence in trigger points in these muscles, resistance, mobility, extensibility, temperature, moisture and roughness or provoking pain. [7]

Postural examination, by Kendall

Postural examination is essential because faulty alignment results in exerting excessive stress on bones, joints, ligaments and muscles. An assessment of joint positions indicates which muscles are in shortened and which are in elongated position. [23]

For a patient after spondylosurgery in lumbar region there will be antalgic position of the trunk with deviation on the opposite side of the lesion, pelvis displaced in the side of the lesion and lumbar in kyphosis. Right hip will be in adduction and left in abduction in case of the lumbar disc herniation affected mostly the right side and shoulder is elevated on the left side for compensating the new adaptive postural pattern. [7]

Gait examination, by Kendall

Gait examination provides us with the objective qualitative information about normal and disturbed pathological motoric function. Any compensating mechanism, in case of a disc herniation there can be observed restriction in hip extension can be evaluated and also decreased plantar with dorsal flexion of the ankle. Gait is evaluated by having the patient walk across the room under observation. [21]

Also present will be asymmetry of the length, small steps and short, slow rhythm and velocity, no upper extremities and trunk synkinesis, pelvis movement – side deviation, quality of toe off, heel off, heel strike phase will be disturbed due to the muscle weakness. [21]

Pathological types of walking: Unstable walking indicates weakness of m. gluteus, walking with shorter lower extremity, antalgic walking in which stance phase is shortened. [21]

Anthropometric measurements

Physiotherapist is able to provide anthropometric measurements of the height, lengths and circumferences of the lower extremities. [20]

Compare the difference in a case of a swelling in lower extremities, for the circumference. Take all measurements in a relaxed position. [20]

***Important finding would be any differentiation in length of the LE.**

Range of motion (ROM), by Kendall

The ROM refers to the amount of motion available in joint. ROM is function of joint morphology, capsules, ligaments, muscles and tendons that cross the joint. Passive ROM refers to the amount of motion attained passively and active the opposite. [24]

ROM classification: limited (hypomobility), physiological or excessive (hypermobility). [24]

Physiotherapist is able to provide measurement of ROM in hip joints (flexion-extension, abduction-adduction, and external-internal rotation), knee joints (flexion-extension) but also ankle joints (dorsal-plantar flexion, inversion-eversion). [7]

Muscle length test, by Janda

The role of assessment of muscle length test for physiotherapist is to determine whether the ROM occurring in the joint is normal, limited or excessive, by the intrinsic joint structures or by the muscles crossing the joint. [25]

Grading muscle shortness can be expressed by Janda: 0 – no shortness, 1 – moderate shortness, 2 – marked shortness. [25]

Physiotherapist is able to provide muscle length testing for muscles around the hip, thigh (quadriceps, hamstrings, iliopsoas, piriformis, hamstrings, tibialis anterior, gastrocnemius, soleus). [7]

Muscle strength test, by Kendall

Muscle strength is a term used for physical force exerted by muscle which is isometric, concentric or eccentric contractions. [26]

The grading physiotherapist uses to evaluate the muscle strength, by Lovett: 0-5 (0 is gone,1 is trace, 2 is poor, 3 is fair, 4 is good and 5 is normal). [5]

Physiotherapist will be able to evaluate the strength of muscle around, thigh, middle leg (gluteii mm. -L5/S1, tensor fasciae latae -L4/L5, quadriceps -L4, adductors -L4, abductors -L5, triceps surrae -S1, tibialis anterior -L5, tibialis posterior - L5/S1, flexor digitorum longus- L5/S1, extensor digitorum longus- L5/S1, extensor hallucis- L5/S1, hamstrings -L5/S1) and trunk. (Thoracic -Th1/12 and lumbar erector spinae -L1/L5, S1/S5). [7]

Soft tissue examination, by Lewit

The soft tissues surrounding the motor system must adapt to all its changes of shape during movement and postural position. Scars play an important role as well, as it concerns reflex changes, in influencing its mobility. The barrier can be normal, gradual and well sprung or restrictive and abrupt – pathological. After the surgery we can provide soft tissue examination (skin, subskin and fasciae of the muscle) on the region of the hip joint, anterior-posterior thighs, calves, back. (Kibler's fold etc.) [7]

Joint play examination, by Lewit

Joint play is passive movement, which cannot be carried out by the patient and comprises a translatory (sliding movement) of one joint surface against the other, or even rotation and also distraction**.** [7]

Interphalangeal joints of toes, in all the directions (dorsal, plantar and lateral side) (both) Metatarsophalangeal joints, in all the directions (dorsal, plantar and lateral side) (both) Calcaneus bone, in lateral and ventral direction and circumduction (both), navicular bone, in dorsal and plantar direction (both) cuboid bone, in dorsal and plantar direction (both), tibiofibular joint in ventral and dorsal direction and patella in caudocranally and lateromedially can be examined in this case. [7]

Neurological examination

Physiotherapist provides as well neurological examination which includes:

General principle: patient's eyes should be closed during the examination. Physiotherapist compares symmetrical areas on the two sides of the body. He/she also compares distal and proximal areas of lower extremities. [28]

Light touch

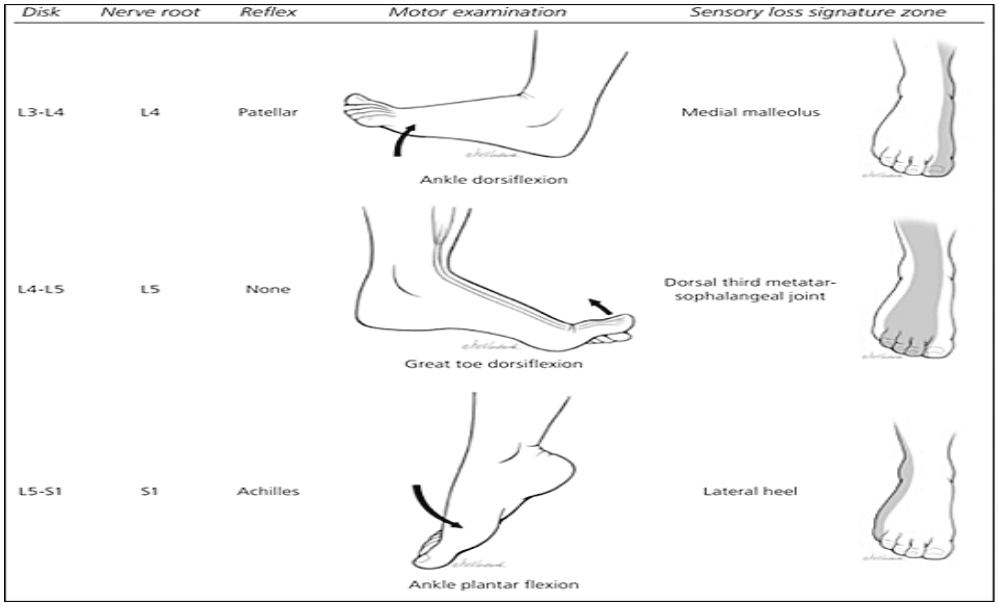
Therapist uses his/her fingers to touch the skin of the patient lightly on both sides simultaneously. He/she tests several areas on lower extremities and patient indicates if the sensation is symmetrical. But in the case of my patient paresthesia is expected in posterior aspect of the lower extremity (right one) till the plantar side of the foot on the lateral side. [28]

Kinesthetic test

Position sense: Therapist grasps the patient's big toe and holds it and then he/she shows the patient "up" and "down". With the patient's eyes closed therapist asks the patient to identify the direction of toe's movement. [28]

Dermatomes examination

Feeling: physiotherapist uses a special sharp object to test "sharp" or "dull" sensation. He/she tests the front of the thighs (L2), medial and lateral aspect of both calves (L4 and L5) and little toes (S1). Hypesthesia will be present in L5, (right) lateral and posterior aspect of lower leg and S1, lateral side of feet on plantar aspect, layers of dermatomes. [28]



Picture 17. Localising neurologic levels. [46]

Deep tendon reflexes

In deep tendon reflexes examination patient must be relaxed and in proper before starting. Reflex response depends on the force of the stimulus. [28]

Reflexes should be graded on a 0 to 2 "plus" scale. That means: 0 is absent, 1+ or + is hypoactive, 2+ or ++ is normal, according to Véle. [28]

Physiotherapist checks knee (patella reflex – L2/L4), also Achilles tendon (L5/S1) and plantar flexors (S1/S2) with the special hummer and hyporreflexia will be noticed in my patient, specifically in the right patella and Achilles tendon reflex. [28]

Therapist also checks for the taxis of lower extremities which indicates the condition of coordination and functioning of central nervous system, especially cerebellum.[7]

Picture 18. Illustration showing Braggard's test. [47]

Straight leg lift test or Laseuge test. This test is a very accurate indicator of a disc herniation . In this test, patient lies on his back and the therapist lifts the affected leg. The knee stays straight. If pain is present down the leg and below the knee, the test is considered to be positive. For more tension therapist provides DF of the ankle and is called Braggard's test (as shown above). [7]

2.6 **Treatment**

2.6.1 Nonsurgical Treatment

In case there are not neurological deficits such as muscle weakness, difficulty walking or cauda equina syndrome, conservative approach is the first choice of treatment. [1]

Common nonsurgical measures include:

Rest is proposed. Often 1-2 days of bed rest will relieve severe back pain. Do not stay off the feet and immobilized for longer, though. Rest breaks throughout the day, would be optimum, but avoiding sitting position for long periods of time. Provide all the movements slow and controlled. Change and modify daily activities so that to avoid movements that can cause further pain, especially bending forward and lifting. [1]

Anti-inflammatory medications. Use of medication that may relieve pain. [1]

Physical therapy. Specific and focused exercises with the appropriate rehabilitation plan can strengthen lower back and abdominal muscles to restore muscle balance.[1]

Epidural steroid injection. In this procedure, steroids are injected into the back region to reduce local inflammation and reduces signs of inflammation. [1]

Of the above measures, only epidural injections have been proven effective at reducing symptoms. There is good evidence that epidural injections can be successful in 42-56% of patients who have not been helped by 6 weeks or more of other nonsurgical approaches. [1]

Lifestyle factors that can influence habitual patterns and relieve low back:

Sitting

A correct sitting position is of great importance. It depends mostly on the chair that we use: the height of the chair is correct if the subject's thighs are horizontal with feet resting on the floor. The back of the chair should provide support of the whole spine where the kyphosis peaks in a position of complete relaxation.(lumbar spine). Specially designed wedged cushions are also recommended in keeping the spine straight. Also forearms and elbows should be rest either on the same level height of the desk or on the forearms rest of the chair. Head should be kept in neutral position neither in anteflexion, retroflexion or rotation. Short breaks should be done and change sitting positions when pain is felt. [7]

Standing

Erect posture should be kept as an ideal position of all the joints. A forward position for a long time as a habitual position in our daily living causes strain, since erector spinae is maximally contracted exerting great pressure on the spinal column. So during flexion of the trunk is recommended to advance one leg while bending the knee at the same time. (e.g. while washing, or cleaning our teeth).[7]

Carrying and lifting

For lifting light objects there must be harmonious synergism of between the trunk and the advanced leg and uncurling of the trunk is accompanied by co-contraction of the abdominal muscles. Heavy objects should be lifted with a straight back while bending and straightening the knees and holding the load close to the trunk, eliminating any leverage effect. [7]

Sleeping position

If patient sleeps in supine positions and the symptoms are present, then the advice would be to put a thick pillow under the legs or a rolled towel under the blanket or if it is possible to adopt a side-lying position. If the patient sleeps in prone position he can use a pillow under the pelvis or more advisable would be to change position. If now patient prefers side-lying, a rolled towel can be used under the waist. [7]

2.6.2 Surgical Treatment

Patients with lumbar disc herniations, diagnosed with signs of neurological deficits or cauda equina syndrome and a common finding is incontinence as mentioned require surgery. They are considered to be in urgent situation and surgery is the next thing to do. [3]

Microdiscectomy is the type of the procedure that is applied. It uses a special microscope to view the disc and nerves. This larger view allows the surgeon to use a smaller cut. This causes less damage to surrounding tissue. When a disc herniation occurs, a fragment of the normal spinal disc is dislodged. This fragment may press against the spinal cord or the nerves that surround the spinal cord. Before the disc material is removed, a small piece of bone (the lamina) from the affected vertebra may be removed (laminotomy). It allows the surgeon to better see the herniated disc. [2]

2.6 Post-operative approach

After any operative procedure, patient undergoes a recovery period with being rest in bed and is explained to him/her the rehabilitation plan that will follow. [16]

Critical concerns for patients are the airway clearance and lung functioning after the anesthetics, prevention of deep venous thrombosis, pain control, loss of muscle mass and strength after immobilization and range of movements of the joints in upper and lower extremities and whole spine. In the case of my patient important to have in mind and take care of are the demanding movements of spine in flexion, extension and lateral flexion that put strain on the lumbar spine and stretching of the fresh scar as well. [16]

In a rehabilitation plan of a postoperative situation of a disc herniation it is vital to achieve core stability first and promote a better controlled postural pattern. The support of the lumbar spine composed of the abdominal and back muscles is the key to focus on. Keeping this support is important during various movements, activities of daily living. Important as well is the endurance force of these muscles that have to be trained too with active exercises. Endurance of the muscles activated in the core stability are trained in a neutral position of the trunk and begin with few and short repetitions that will gradually continue into longer repetitions. [16]

The exercises that are given in the beginning are performed in different positions eventually as the days pass with participation of arm and leg movements. [16]

The treatment plan includes stretching of shortened muscles, such as Hamstrings and Quadriceps that influence hip and knee movements. In order to get the patient in a correct walking stereotype these joint should gain their range of motion. Important also for walking is the activation of gluteii muscles so strengthening of these muscles would allow to the patient to start training his gait pattern improve quality of motoric functioning and as a consequence patient will able to provide the demands of his/her lifestyle when the strength and power are gained . [16]

Along with that we can apply sensomotoric exercises (small foot) to increase proprioception and improve stability of the axial system. [7]

Also promote relaxation techniques of tensed muscles along with breathing and TEP exercises/vein gymnastics to conclude the treatment plan (DF-PF-circumduction in ankle joints), as in every post-operative treatment, so that to prevent any circulatory deficit. [7]

In an advance level of exercises patient, depending as well on the physical possibilitities of the patient, he /she can provide the strengthening and elongating exercises with a theraband, balancing and stability exercises on posturomed or on a gymnastic ball introducing special exercises for spine in general, low back and pelvis with hips or she can join an aquatic programme/hydrotherapy where movements will be more fluent without the influence of gravity. [7]

General guidelines after a spondylosurgery for the patient to follow:

- Instruct how descend from the bed and return with prone positioning model, keeping the spine in a straight line. From the first day after the surgery.
- Guidelines for transitioning movements in bed from supine to prone etc. From the first day after the surgery.
- Instruct walking and train weight bearing (with or without crutches, depends on the patient’s condition). From the first day after the surgery.
- Instructions how to keep the correct position in the toilet.

- Instruct light sitting with straighten back and extended elbows. From the third day. [16]

3.
SPECIAL PART

3. Methodology

My clinical work practice took place in Ústřední Vojenská Nemocnice in Praha. It was started on Monday 16th of January 2012 and finished on Friday 27st of January 2012 (10days). Each day had the duration of 8 hours. The total amount of the hours of my practice was 80.

My clinical work placement was supervised by Mgr. Agnieszka Kaczmarská Ph.D. The sessions with my patient were four. They were started on Thursday 19th of January 2012 and they were continued day by day. Our last session was on Tuesday 23st of January 2012.

Mainly the therapeutic procedures that I used were manually therapy which took place in our individual therapy room in the department of spondylosurgery. I used mostly my hands for the examination and therapy. Goniometers, measurement tape, neurological hammer were the tools that I used for the examination procedures. The patient had a plaster covering the scar and the blood infusion tubes.

The patient was fully aware of the examination and therapeutic procedures at any given time, no invasive methods were used and a proposed informed consent was also assigned by the patient and me.

My work has been approved by the Ethics Committee of the Faculty of Physical Education and Sport at Charles University, under the approval number 080/2012.

Student: Krokou Anastasia

Workplace: UVN, Ústřední Vojenská Nemocnice - Department of neurosurgery (spondylochirurgie)

Supervisor: Mgr. Agnieszka Kaczmarská Ph.D

Date: 19/1/2012 -23/1/2012

Examined person: J.B, 1974, FEMALE **Code**: M511

Diagnosis: Disc herniation and spondylolisthesis of L5/S1. (Right side)

Patient was suffering from chronic lumbalgia due to her active and intense condition since she was a table tennis player and her postural, habitual and repetitive pattern while playing was overloading her lower back region causing over the time inflammation and pain to the structures of lumbar spine. She mentioned that these sharp attacks of pain were localised on lower back with projection of it mostly to her right lower extremity on posterior side and all the way down to the plantar aspect of her right feet. She mentioned that bending forward was causing pain in low back region, and it was difficult for her to change positions in bed during night. Pain level in a scale 1-10 (10 is maximum) she mentioned 7 in acute situations.

Mechanism of the injury:

Two weeks ago she felt an irritation and piercing pain at the region of low back, while she was trying to lift up her baby from the floor. The symptoms that occurred from that moment were paresthesia in sensation in lower extremities, irritation, numbness feeling and weakness in legs, mostly on the right one. She immediately visited the hospital after the incidence and doctors diagnosed disc herniation and spondylolisthesis of L5-S1 due to disproportional loading on the structures of lumbar spine and muscle disbalance over a period of time and after the acute injury followed from improper deep flexion of trunk. She was then operated for decompression of L5-S1 with microdiscectomy (laminotomy) procedures and no complications were referred.

Present state:

Patient lies on bed and is on first day after the operation of decompression at L5-S1 region, which occurred on 18/1/2012. She had the problem of chronic low back pain, and two weeks ago she was diagnosed with disc herniation after bad pattern mechanism of lifting an object from a lower level. Before the surgery she had stiff low back pain and radiation of pain from the buttocks in lower extremities, mostly in the right leg. Laseuge test was positive before operation at 45˚, and she feels released now with no pain. She mentioned only pain in the scar. She now wears anti-embolism long socks for prevention. She also has a plaster cover on the scar and the blood infusion tubes.

Personal characteristics of the patient:

Height: 1.62m, Weight: 72Kg, BMI: 27.43

Pain level: 5 out of 10 (ten is considered to be maximum)

HR: 60 beats/min

BP: 120/70 mmHg

Temperature: 36.7 ˚C

3.2 Anamnesis:

Family anamnesis: Mother is healthy. Father also suffers from chronic low back pain.

Personal anamnesis: Patient had normal childhood diseases. She suffers only from varicose vein on both lower extremities.

Social anamnesis: She has three healthy children. She is married and lives with her husband, so she gets help for her ADL. They live in a flat on the third floor with elevator. She is very friendly, cooperative and orientated.

Occupational anamnesis: She works as an assistive sister in an operation room and also as a table tennis instructor for the children. This period is on a maternity license, she gave a birth 12 months ago.

Gynecological anamnesis: J.B delivered three births physiologically with no complications. Menstrual cycle started at the age of 12 and the cycle is stable every time, no problems mentioned.

Operation anamnesis: Patient was treated surgically after being diagnosed with disc herniation, by decompressing the irritated nerve roots L5/S1. They provided microdiscectomy with laminotomy at these segments and no complications were referred. The operation took place on 18.1.2012 at Ústřední Vojenská Nemocnice. Patient was suffering for a long time from lumbalgia.

Pharmacological anamnesis:

Chronic medication: LMWA (Low Molecular Weight Antioxidants for the antioxidative defense mechanism)

Current medication: analgetics (relieve from pain), infuse

Hobbies: She used to play intensively table tennis and also working as an instructor for the young table-tennis players for many years. She was spending about two hours in a daily basis each week.

Allergies: Cefzil (an antibiotic that is used to treat mild to moderate infections).

Previous injuries and trauma: None

Abuses: She drinks alcohol occasionally and has stopped smoking at the age of 20 years old.

3.2.1 Previous rehabilitation:

She used to go for physiotherapy sessions so that to relieve pain in low back pain. Pain was controlled and therapies were effective. She was treated with manual techniques, electrotherapy (TENS current, IF current, diathermy etc), mechanotherapy and hydrotherapy.

3.2.2 Statement from the patient's medical documentation:

MRI statements were available and there was shown the site of the lumbar disc herniation at the segments of L5/S1, with the bulging of nucleus pulposus pressing in this way the nerve roots at that region.

3.2.3 Indication of rehabilitation:

Doctor suggested a physiotherapeutic programme that includes first of all verticalisation of the patient. Instructing her how to raise and lie on bed. Train walking in the room, afterwards in the corridor. Then active exercises in hip joint (F,E) and strengthening exercises in isometric contraction for hip flexors, abdominals, gluteii muscles and abductors and increase ROM in these directions**.** Also breathing exercises for increasing the capacity of lungs and remove anaesthetics. Correct of muscle disbalance and walking stereotype. Promote relaxation of muscles along with breathing and TEP exercises/vein gymnastics. (DF-PF-circumdaction in ankle joints).

3.2.4 Differential diagnosis:

- Motoric deficit and muscle weakness at the level of L5-S1 innervation of gastrocnemius and ankle plantar flexion. (Mostly on the right side).
- Sensory deficit of lateral aspect of calf and plantar side of feet till the heel. (Mostly on the right side).
- Altered reflex of Achilles tendon. (Mostly on the right side).
- Pain on the posterior aspect of right thigh and calf.

Subjective feeling of the patient:

- She feels pain mostly on the scar and less on low back, and posteriorly of right lower extremity.
- Muscle weakness of right lower extremity and more in the direction of plantar flexion and extension of the big toe.

3.3 INITIAL KINESIOLOGIC EXAMINATION:

I. Observation
II. Postural examination
III. Palpation of pelvis
IV. Anthropometric examination
V. Muscle Tone Examination (palpation), by Lewit
VI. Soft tissue examination, by Lewit
VII. Gait examination
VIII. Movement patterns
IX. ROM examination, by Kendall
X. Muscle strength test, by Kendall
XI. Muscle length test, by Janda
XII. Joint play examination, by Lewit
XIII. Breathing examination
XIV. Neurological examination

3.3.1 Observation:

- Patient wears the special anti-embolism socks.
- Slight oedema at the region of low back and at the region of scar.
- External rotation of the both lower extremities and slight abducted.
- She lies with flat back on the bed, left lateral flexion of the trunk.
- Abdominal and upper chest breathing.
- Scar: covered with a sterile plaster.

3.3.2 Postural examination:

POSTERIOR VIEW

• Slight valgosity of Achilles tendon on both sides
• Slight varosity of the right calf
• Popliteal lines in external rotation of both knee joints
• Slight higher gluteal line in the right side
• ASIP slight higher on the right side
• Slight lateral flexion of trunk to the left side
• Trunk bends slight forward
• Left shoulder slight higher
• Thoraco-axillar triangle slight bigger on the left side
• Left scapula slight abducted

Table 1- Postural examination, posterior view

ANTERIOR VIEW

• More weight bearing on the left lower extremity and slight semiflexion of right knee.
• More weight bearing on lateral aspect of foot for the left lower extremity and more on the medial and metatarsal heads for the right lower extremity.
• Slight hallux valgus on both feet
• Slight varosity of the right calf
• Slight external rotation of both patella joints, but mostly seen on the right one
• Hypertrophy of quadriceps m. in both legs
• ASIP slight higher on the right side
• Slight lateral flexion of trunk to the left side
• Left shoulder slight higher
• Thoraco-axillar triangle slight bigger on the left side
• Right clavicle slight higher on the left side

• Slight lateral flexion of head to the right side

Table 2- Postural examination, anterior view

LATERAL VIEW

RIGHT SIDE
• More weight bearing on the medial aspect of foot and metatarsal heads
• Hyperextension of knee joint
• Slight rotation of trunk to the right side
• Slight flexion in hip joint
• Slight anterior tilt of pelvis
• Slight kyphosis in thoracic spine (mostly seen in upper thoracic)
• Arms protracted
• Slight head forward

Table 3-Postural examination, lateral view (right side)

LATERAL VIEW

LEFT SIDE
• More weight bearing on the lateral aspect of foot
• Slight semiflexion of knee joint
• Flexion in hip joint
• Slight rotation of trunk to the right side
• Slight anterior tilt of pelvis
• Slight kyphosis in thoracic spine (mostly seen in upper thoracic)
• Arms protracted
• Slight head forward

Table 4-Postural examination, lateral view (left side)

3.3.3 Palpation of pelvis:

- Iliac crest: Slight higher on the right side.
- ASIS: Slight higher on the right side.
- PIIS & ASIS in transversal plane- right and left side: slight torsion to the left side.

*When lying ASIS are in the same line.

3.3.4 Anthropometric Measurements

Lower extremities length

	Sinistra	Dexter
Functional length	94cm	95cm
Anatomical length	85cm	86cm
Thigh	47cm	48cm
Lower leg	37cm	38cm
Sole	22cm	22cm

Table 5- Anthropometric measurements for length of LE

***There is slight differentiation of length of lower extremities. Right is slight longer.**

Lower extremities circumference

	Sinistra	**Dexter**
10cm above patella	42cm	43cm
15cm above patella	47cm	48cm
Lower leg	35cm	37cm
Waist	92cm	
Hips	90cm	

Table 6- Anthropometric measurements for circumference of LE

3.3.5 Muscle Tone Examination (palpation), by Lewit

Tested muscle	**Sinistra**	**Dexter**
Rectus Femoris	Eutone	Hypertone
Vastus medialis, intermedialis, lateralis	Eutone	Hypertone
Adductors	Tension	Hypertone
Iliopsoas	Tension	Hypertone
Piriformis	Tension	Hypertone
Tensor fasciae latae	Eutone	Hypertone
Erector spinae (thoracic and lumbar part)	Hypertone	Hypertone
Gluteii	Tension	Tension
Hamstrings	Tension	Hypertone

Gastrocnemius	Tension	Hypertone
Tibialis anterior	Tension	Tension
Abdominals (upper and lower)	Hypertension	Hypertension
Achilles tendon	Tension	Hypertension

Table 7- Muscle tone examination, by Lewit

3.3.6 Soft tissue examination, by Lewit

- Examination of skin and subskin in all directions (caudal, cranial, medial and lateral) of LE and back: restricted barrier in all directions more of the right thigh, calf.

- Examination of fasciae by wave technique of LE and back: restricted barrier more of right thigh, calf.

3.3.7 Gait Examination

Narrow base
Short steps
Dragging of the right leg
Slight valgosity of Achilles tendon
Slight varosity of calf, more on the right side
Extension of right knee was not obtained (left one in semiflexion)
Slight external rotation of both patella joints, but mostly seen on the right one
More weight bearing on medial sides of feet and metatarsal heads and less on heels
Less motion in DF and PF of right ankle joint
Trunk bends forward and shifted to left side

Stiff trunk
Ipsilateral rotation of trunk and pelvis and motion of the arms
Less swinging motion in both upper extremities
Arms protracted
Slight head forward
Slight kyphosis in thoracic spine (mostly seen in upper thoracic)

Table 8- Gait examination

*After verticalisation she felt slight vertigo.

3.3.8 Movement patterns

Hip abduction (sidelying position):

- Tensor mechanism in both lower extremities.
- Secondary activation of gluteus medius in both sides.

Hip extension (prone position):

- First activation of contra lateral erector spinae mm. (lumbar part) for both sides and right after gluteus maximus mm**.**

3.3.9 ROM Examination, by Kendall

According to SFTR method

HIP JOINT				
Plane	**Sinistra**		**Dexter**	
	Active Movement	**Passive Movement**	**Active Movement**	**Passive Movement**
S	5 -0- 75	10 -0- 80	5 -0- 65	5 -0- 70
S*	5 -0- 110	10 -0- 115	10 -0- 100	15 -0- 105
F	40 -0- 5	45 -0- 10	30 -0- 5	35-0-10

Table 9- Range of motion examination (hip joint), by Kendall

*With flexed knee

KNEE JOINT				
Plane	**Sinistra**		**Dexter**	
	Active Movement	**Passive Movement**	**Active Movement**	**Passive Movement**
S	0 – 0 - 110	0 – 0 - 120	0 – 0 - 100	0 – 0 –105

Table 10- Range of motion examination (knee joint), by Kendall

ANKLE JOINT				
Plane	**Sinistra**		**Dexter**	
	Active Movement	**Passive Movement**	**Active Movement**	**Passive Movement**
S	30 -0- 10	35 -0- 20	20 -0- 10	25 -0- 15

Table 11- Range of motion examination (ankle joint), by Kendall

3.3.10 Muscle Strength Test, by Kendall

Tested muscle	Sinistra	Dexter
Quadriceps Femoris	4+	4+
Adductors	4	4
Abductors	4	4
Gluteii	4+	4
Tibialis anterior	4+	4
gastrocnemius	4+	4
hamstrings	4+	4

Table 12- Muscle strength examination, by Kendall

*During strength test of right lower extremity`s muscles, the patient feels pain in right knee region.

3.3.11 Muscle Length Test , by Janda

Tested muscle	Sinistra	Dexter
Pectoralis major & minor	1	1
Hamstrings	1	1
Iliopsoas	1	1
Gastrocnemius	0	1
Soleus	0	1
Rectus femoris	0	0
Tensor fasciae latae	0	0

Table 13- Muscle length examination, by Janda

*Scale according to Janda: 0- no shortness, 1-moderate shortness, 2- marked shortness.

3.3.12 Examination of joint play, by Lewit

JOINT	Sinistra	Dexter
Tibiofibular joint on rotation (IR-ER)	not restricted	not restricted
Tibiofibular joint on dorsal and ventral direction	not restricted	not restricted
Patellar on all directions (cranial, caudal, medial, lateral)	slight restriction in caudocranial direction	slight restriction in caudocranial direction
Interphalangeal joints of toes, in all the directions (dorsal, plantar and lateral side)	Restricted in all directions	Restricted in all directions

Metatarsophalangeal joints, in all the directions (dorsal, plantar and lateral side)	Restricted in all directions	Restricted in all directions
Calcaneus bone, in lateral and ventral direction and circumdaction	slight restriction	slight restriction
Navicular bone, in dorsal and plantar direction	slight restriction	slight restriction
Cuboid bone, in dorsal and plantar direction	slight restriction	slight restriction
Taloclural joint in dorsal direction	no resistance is felt	no resistance is felt

Table 14- Joint play examination, by Lewit

3.3.13 Breathing examination:

- Shallow and superficial breathing.
- Upper chest and low abdominals are involved mostly in her breathing.
- No expansion of rib cage.
- No good activation of abdominal muscles and diaphragm.

3.3.14 Neurological examination:

Laseuge test:

- Negative for the left one. (Only stretching feeling at 70˚).
- Negative for the right one. (Only stretching feeling at 60˚).

Taxis for LE:

- Negative for both sides.

Superficial sensation

Light touch

Hypesthesia in the right lower extremity along the lateral and posterior aspects till the plantar side of the foot on lateral aspect.

Dermatomes examination

	Sinistra	**Dexter**
Dermatomes of L5 segment	no symmetry	asymmetry (hypesthesia)
Dermatomes of S1 segment	no symmetry	Asymmetry (hypesthesia)

Table15- Neurological examination- dermatomes examination

Kinesthetic - *Position sense*

	Sinistra	**Dexter**
Big toe	Normal response	Normal response
1^{st}-5^{th} toes	Normal response	Normal response

Table 16- Neurological examination- position test

Deep Tendon reflexes

Type of reflex	**Sinistra**	**Dexter**
Patella reflex L3-L4	2+	2+
Achilles reflex L5-S2	2+	1+
Medioplantar reflex	2+	1+

Table 17- Neurological examination- Deep tendon reflexes

*Evaluation grades, according to Vele

2+ = Normal

3.3.15 Conclusion of examination:

- Patient feels pain in low back region and at the region of scar.
- Weakness in muscles of lower extremities. (Quadriceps, adductors, abductors, gastrocnemius, tibialis anterior, hamstrings mm.) and that has as a consequence muscle disbalance and disturbed movement patterns.
- Tension and hypertonicity in muscles in lower extremities. (Quadriceps, adductors, tensor fasciae latae, iliopsoas, piriformis, erector spinae –lumbar part, gastrocnemius, hamstrings mm.).
- Decreased ROM in direction of F, E of hip joint and F of knee and PF with DF of ankle joint of right lower extremity. Also extension in knee joint is not obtained while walking. (Mostly for the right one).
- Tension of soft tissue more in the right thigh and calf, paravertebral m, thoracolumbar fasciae, having restricted barrier, less elasticity and extensibility in all directions (cranial, caudal ,medial, lateral).
- Shortness in muscles (pectoralis major & minor, hamstrings, iliopsoas, gastrocnemius, soleus mm.).
- Weak reflexive response for Achilles tendon (L5-S1) and medioplantar reflex (S1-S2).(Right side)
- Hypesthesia in lateral and posterior aspect of lower leg and plantar aspect of foot.L5 and S1 dermatomes. (Right side).
- Restricted joint play in interphalangeal, metatarsophalangeal joints in dorsal, plantar and lateral directions. Also navicular, calcaneous and cuboid bones in all directions (dorsal and plantar).
- Disturbed breathing pattern, no expansion of chest and thorax.

***Note**: patient finds it difficult to relax in general.

3.4 Short-term and long-term rehabilitation plan:

3.4.1 Short-term rehabilitation plan:

- Verticalisation of patient in upright position.
- Train walking along the corridor to get power on lower extremities and afterwards train ascending and descending the stairs.
- Relaxation of the muscles. (pectoralis major and minor, quadriceps, adductors, tensor fasciae latae, iliopsoas, piriformis, gastrocnemius mm.), Promote strengthening in weak muscles (quadriceps, adductors, abductors, gastrocnemius, tibialis anterior, hamstrings, glutei mm.) and stretching for pectoralis major & minor, hamstrings, gastrocnemius, soleus mm. in order to improve muscle imbalance and after that improve the movement stereotypes.
- Improve sensation in L5-S1 regions where there is hypesthesia.
- Release tension from soft tissue in right thigh/ calf and increase elasticity and mobility of the superficial and deep layers.
- Release restriction in MTP, IP joints and cuboid, calcaneous and navicular bones.
- Improve movement patterns and quality of the acting muscles.
- Improve standing, sitting and walking stereotype.
- Increase ROM in hip joint F, E and in knee joint F, E, ankle joint DF, PF, Inversion, Eversion and flexibility with restoration of joint motion.
- Prevent thromboembolism with vein gymnastics and muscle pump exercises.
- Improve breathing pattern, increase lung capacity and remove the anesthetics.
- Deep stabilization system exercises for improving posture, coordination exercises as well as and techniques for restoring balance and reeducating the central nervous system for the correct postural pattern.
- Instruct also healthy ways of providing habitual patterns (sitting, lifting something from the floor, carrying, standing and sleeping).

3.4.2 Long-term rehabilitation plan:

- Maintain results from short RHB plan.
- Correct walking pattern of patient.
- Coordination exercises and sensomotoric exercises, by Janda.
- Conditioning exercises for improving flexibility.
- Hydrotherapy, which is advantageous since it eliminates the gravity forces on spinal segments and are more free able to move.
- Able to return back to ADL.

3.4.3 Therapy suggestion:

- Active exercises (F in hip joint and F in knee joint) in bed and afterwards in standing position for strength and increase ROM in these joints.
- Verticalisation through prone position of patient and train for correct walking pattern (3 tect, heel, medial and lateral aspects of feet and metatarsal heads are the press points) - instruct patient, along the room, improving muscle strength and power in lower extremities.
- Breathing exercises and localized breathing techniques (for better mobility of rib cage and activation of diaphragm and abdominal muscles).
- Strengthening exercises in bed in all positions and in standing as well (quadriceps, adductors, abductors, gastrocnemius, tibialis anterior, hamstrings, gluteus mm.) with isometric contraction of the muscles and active movements.
- PIR techniques, by Lewit for releasing tension in muscles (Quadriceps, adductors, tensor fasciae latae, iliopsoas, piriformis, erector spinae –lumbar part, gastrocnemius mm.), and relax these muscles.
- Release tension from soft tissue, by soft tissue techniques, by Lewit in right thigh, calf and increase elasticity and extensibility of these deep layers investing the muscles.
- Joint play techniques, by Lewit to release restriction from MTP, IP joints and cuboid, calcaneous and navicular bones.

- Deep Stabilization System exercises for better control of pelvis and trunk. Also coordination movements training.
- Sensomotoric exercises, by Janda to improve proprioception and better signaling for correct body posture and joint positioning.
- Improve sensation, applying facilitation and stimulation techniques with a soft ball, of right lower extremity.
- TEP exercises/vein gymnastics.

3.5 THERAPY PROGRESS

Thursday on 19.1.2012

Goals of today's therapeutic unit:

- Reduce post-operative pain and edema with active movements in hip, knee and ankle joints.
- Prevent thromboembolism (muscle pump exercises).
- Train transitioning positions and verticalisation.
- Release tension from soft tissues with soft tissue techniques, by Lewit in right thigh, calf and increase elasticity and extensibility.
- Increase strength in weakened muscles quadriceps, adductors, abductors and increase ROM in hip joint (F, E), in knee joint F and in ankle joint PF and DF, with active movements.
- Unblock restricted joints with Joint play techniques by Lewit for:
  Interphalangeal joints of toes, in all the directions (both), Metatarsophalangeal joints (both), dorsal & plantar fan as well (both sides).
- Correct breathing stereotype, increase lung capacity and expansion of thorax.

Execution:

1. Soft tissue techniques, by Lewit: Applied on right thigh, calf (anterior, posterior side) in all directions (caudocranial, mediolateral).
2. TEP exercises in supine position: dorsal flexion and plantar flexion of the ankle joints and circumduction Repeat and change direction. *5 minutes, repetitions each hour. Isometric contraction of quadriceps while dorsal flexing ankle and extending knee joint (muscle pump).Repeat x10 times.
3. Active movements for increase strength and ROM in quadriceps, adductors abductors, calf muscles**:**
   - In supine position: Flexion of hip joint along with flexion of knee joint (when flexing hip).Actively and passively repeated 7 times. Also adduction and abduction movements of hip joint. Repeat 6 times. Also active movements and with resistance DF and PF of ankle. Repeat 7 times.
4. Joint play techniques by Lewit for: Interphalangeal joints of toes, in all the directions (dorsal, plantar and lateral side) (both), Metatarsophalangeal joints in all the directions (dorsal, plantar and lateral side) (both), dorsal & plantar fan as well (both sides).
5. Breathing exercises: Our aim is to increase mobility of rib cage and activation of diaphragm and abdominal muscles. Put local pressure along ribs, and then abdomen and instruct patient to breathe deeply. Repeat 6-7 times.
6. Verticalisation – train transitioning positions (from supine to prone), improving muscle strength and power in lower and upper extremities. The main principle for changing positions is to keep straight alignment of the spine and not to bend forward or backward.

Results:

Objective:

After the therapy the patient was still in pain but she was feeling better than before and she was able to perform verticalisation with no great effort the second time that we performed it. She also got slight pale. She can easily manage to change positions from supine to prone lying.

Subjective:

There was noticed light increase in ROM when repeating the movements in hip and ankle joints in the direction of PF and DF. Approximately 5 degrees was the difference. Also slight release of tension after the application of soft tissue techniques on right thigh, calf (anterior, posterior side) in all directions (caudocranial, mediolateral) was there.

Self therapy:

She can provide by herself actively flexion of hip joint along with flexion of knee joint (when flexing hip).Repeated 7-10 times. Also TEP exercises and repeat 5 min each hour. Breathing exercises were instructed too. She was told to raise both arms, breathe deeply and release. Repeat 5-6 times daily. (Activate abdominal muscles and diaphragm).

Friday on 20.1.2012

Goals of today's therapeutic unit:

- Prevent thromboembolism, vein gymnastics.
- Reduce post-operative pain and edema with active movements in hip, knee and ankle joint.
- Release tension from soft tissues with soft tissue techniques, by Lewit in right thigh, calf and increase elasticity.
- Increase strength in weakened muscles (quadriceps, adductors, abductors, gluteal mm.) and increase ROM in hip joint (F, E) in knee joint F and in ankle joint PF and DF in supine and standing position with support.
- Unblock restricted joints with Joint play techniques by Lewit for:
  Interphalangeal joints of toes, in all the directions (both), Metatarsophalangeal joints, in all the directions (both), dorsal and plantar fan as well (both sides).
- Achieve stabilisation of trunk and pelvis in supine position (hip bridge).
- Train walking (3 tect- heel, medial and lateral aspects of foot and metatarsal heads press points) to gain power and muscle strength in lower extremities.
- Correct breathing stereotype and increase expansion of thorax.

Execution:

1. Soft tissue techniques, by Lewit: Applied on right thigh, calf (anterior, posterior side) in all directions (caudocranial, mediolateral).
2. TEP exercises in supine position: dorsal flexion and plantar flexion of ankle joint and circumduction Repeat and change direction. *5 minutes, repetitions for each hour. Isometric contraction of quadriceps while dorsal flexing ankle and extending the knee (muscle pump). Repeat x10 times.
3. Active movements for increase strength in quadriceps, adductors abductors, pelvic floor muscles, calf muscles, abdominals and gluteal m.**:**
   - In supine position: Flexion of hip joint along with flexion of knee joint (when flexing hip). Actively and passively repeated 7 times. Also adduction and abduction movements of hip joint. Repeat 6 times. Also active movements and with resistance DF and PF of ankle. Repeat 7 times.
   - In supine position: Hip bridge to activate pelvic floor muscles and abdominals as well. Repeat 6-7 times.
   - In standing position: Flexion of hip joint along with flexion of knee joint (when flexing hip) and E as well in hip joint while holding on bed. Actively repeated 7 times. Also adduction and abduction movements of hip joint. Repeat 6-7 times.
4. Joint play techniques by Lewit for: Interphalangeal joints of toes, in all the directions (dorsal, plantar and lateral side) (both), Metatarsophalangeal joints, in all the directions (dorsal, plantar and lateral side) (both), dorsal & plantar fan as well (both sides).
5. Achieve stabilisation of trunk and pelvis in supine position. Patient provides hip bridge and physiotherapists press laterolaterally the region of pelvis rhythmically and patient tries to stabilise and keep a balance position of pelvis and trunk. In standing position tries with bent knees and externally rotated to keep the posture. Repeat 4-5 times.
6. Walking along the corridor, improving muscle strength and power in lower extremities (instruct 3 tect walking)

Results:

Subjective:

After the therapy the patient was feeling better in regarding to pain. She felt quite dizzy but confident while walking and she told me that she could extend more the big toe than yesterday.

Objective:

Slight increase in ROM when repeating the movements in hip in the direction of F and E in standing position and ankle joints in the direction of PF and DF. Walking was along the corridor and there is better motion in the hip joint in the direction of E and in ankle joint in the direction of DF and PF. Also slight release of tension after the application of soft tissue techniques on right thigh, calf (anterior, posterior side) in all directions (caudocranial, mediolateral).

Self therapy:

She can provide by herself actively flexion of hip joint along with flexion of knee joint (when flexing hip) and E in standing position with support as well as ABD and ADD. Repeated 7-10 times. Also TEP exercises and repeat 5 min each hour. Also walking is instructed while being observed. Breathing exercises were told to repeat too, to expand the lungs. She was told to raise both arms, breathe deeply and release. Repeat 5-6 times daily. (Activate abdominal muscles and diaphragm).

Monday on 23.1.2012

Goals of today's therapeutic unit:

- Prevent thromboembolism, muscle pump exercises.
- Release tension from soft tissues with soft tissue techniques, by Lewit in right thigh-calf and increase elasticity and mobility.
- Relax with the application of PIR method, by Lewit tensed muscles and promote muscle balance and then stretch them (quadriceps, adductor, and gastrocnemius mm.).
- Increase strength in weakened muscles (quadriceps, adductors, abductors, gluteal mm.) with isometric contraction and increase ROM in hip joint (F, E), in knee joint F and in ankle joint PF and DF in standing position with support.
- Unblock restricted joints with Joint play techniques by Lewit for:
  Interphalangeal joints of toes, in all the directions (both), Metatarsophalangeal joints, in all the directions (both), dorsal & plantar fan as well (both sides).
- Achieve stabilisation of trunk and pelvis in supine position.
- Sensomotoric exercises (small foot), by Janda for correct distribution of weight and improve proprioception.
- Correct walking (3 tect) to achieve power and muscle strength in lower extremities.

Execution:

1. Soft tissue techniques, by Lewit: Applied on right thigh, calf (anterior side) in all directions (caudocranial, mediolateral).
2. TEP exercises in supine position: dorsal flexion and plantar flexion of ankle joint and circumduction. Repeat and change direction. *5 minutes repetitions for each hour. Isometric contraction of quadriceps while dorsal flexing ankle and extending the knee (muscle pump). Repeat x10 times.

3. Active movements for increase strength in quadriceps, adductors abductors, pelvic floor muscles, calf muscles, abdominals and gluteal mm.**:**
   - In supine position: Flexion of hip joint along with flexion of knee joint (when flexing hip). Actively repeated 7 times. Also adduction and abduction movements of hip joint. Repeat 6 times. Also active movements and with resistance DF and PF of ankle. Repeat 7 times.
   - In supine position: hip Bridge to activate pelvic floor muscles and abdominals as well. Repeat 6-7 times.
   - In standing position: Flexion of hip joint along with flexion of knee joint (when flexing hip) and E as well while holding on bed. Actively repeated 7 times. Also adduction and abduction movements of hip joint. Repeat 6 times.
4. PIR method, by Lewit for the tensed muscles and promote muscle balance (quadriceps, adductors, gastrocnemius mm.).
5. Joint play techniques by Lewit for: Interphalangeal joints of toes, in all the directions (dorsal, plantar and lateral side) (both), Metatarsophalangeal joints, in all the directions (dorsal, plantar and lateral side) (both), dorsal & plantar fan (both sides).
6. Achieve stabilisation of trunk and pelvis in supine position. Patient provides hip bridge and physiotherapists press laterolaterally the region of pelvis, rhythmically and patient tries to stabilise and keep a balance position of pelvis and trunk. In standing position tries with bent knees and externally rotated to keep the posture. Repeat 4-5 times.
7. Sensomotoric exercises (small foot), by Janda. Train 3 tect walking and distribute correct weight bearing in these points. In standing position patient tries to bring metatarsal bone close to heel and form a bridge. Then patient tries to move forward with this principle and backward. Repeat 6-7 times. Afterwards tries to bend slight front the whole trunk based on 3 points.
8. Walking along the corridor, improving muscle strength and power in lower extremities and correct her postural stereotype.

Results:

Subjective:

She feels more confident while walking and better motion in hip joint (F, E, ABD, ADD) and ankle joint (PF, DF).

Objective:

Slight increase in ROM when repeating the movements in hip joint in the direction of F, E and ankle joints in the direction of PF and DF. While walking there is good activation of gluteus m during E in hip joint (both) and also in ankle joints in direction of PF and DF and correction of valgosity of Achilles tendon. Also slight release of tension after the application of soft tissue techniques and increase of elasticity and extensibility on right thigh, calf (anterior side) in all directions (caudocranial, mediolateral)

Self therapy:

She can provide by herself actively flexion of hip joint along with flexion of knee joint (when flexing hip).Repeated 7-10 times. As well as E of hip joint ABD and ADD in standing position with support on the bed. Also TEP exercises and repeat 5 min each hour. Breathing exercises were instructed too. She was told to raise both arms, breathe deeply and release. Repeat 5-6 times daily (Activated abdominal muscles and diaphragm).

- ❖ We could not apply the special tests at the very first day because of the pain and the weakness of the patient and musculature mostly, but now I considered the best chance to provide it:

- **Special tests:**

Romberg I: Negative

Romberg II: Negative

Romberg III: Negative (slight instability and forward bending of the whole body**)**

Trendelenburg test:

Left leg: Negative

Right leg: Positive (disbalance and weak gluteus medius mm. Also compensation of the movement with elevation of pelvis was noticed.

Tuesday on 24.1.2012

Goals of today's therapeutic unit:

- Prevent thromboembolism
- Release tension from soft tissues with soft tissue techniques, by Lewit in right thigh-calf and increase elasticity.
- Relax with the application of PIR method, by Lewit tensed muscles and promote muscle balance (quadriceps, adductors, gastrocnemius mm.).
- Active movements for increase strength in muscles (quadriceps, adductors, abductors, gluteal mm.) and increase ROM in hip joint F,E, in knee joint F and in ankle joint PF and DF in standing position with support.
- Unblock restricted joints with Joint play techniques by Lewit for:
  Interphalangeal joints of toes, in all the directions (both) Metatarsophalangeal joints, in all the directions (both), dorsal & plantar fan as well (both sides).
- Achieve stabilisation of trunk and pelvis in supine position.
- Sensomotoric exercises (small foot), by Janda for correct distribution of weight and promote better information from proprioceptors to correct body position
- Correct walking to gain power and muscle strength in lower extremities

Execution:

1. Soft tissue techniques, by Lewit: Applied on right thigh, calf (anterior, posterior side) in all directions (caudocranial, mediolateral)
2. TEP exercises in supine position: dorsal flexion and plantar flexion of ankle joint and circumduction Repeat and change direction. *5 min each hour. Isometric contraction of quadriceps while dorsal flexing ankle (muscle pump).Repeat x10 times.

3. Active and passive movements for increase strength in quadriceps, adductors abductors, pelvic floor muscles, calf muscles, abdominals and gluteii mm.**:**
   - In supine position: Flexion of hip joint along with flexion of knee joint (when flexing hip). Actively and passively repeated 7 times. Also adduction and abduction movements of hip joint. Repeat 6 times. Also active movements and with resistance DF and PF of ankle. Repeat 7 times.
   - In supine position: Hip bridge to activate pelvic floor muscles and abdominals as well. Repeat 6-7 times.
   - In standing position: Flexion of hip joint along with flexion of knee joint (when flexing hip) and E as well while holding on bed. Actively repeated 7 times. Also adduction and abduction movements of hip joint. Repeat 6 times.
4. PIR method, by Lewit for the tensed muscles and promote muscle balance (quadriceps, adductors, gastrocnemius mm.)
5. Joint play techniques by Lewit for: Interphalangeal joints of toes, in all the directions (dorsal, plantar and lateral side) (both), Metatarsophalangeal joints, in all the directions (dorsal, plantar and lateral side) (both), dorsal & plantar fan as well (both sides).
6. Achieve stabilisation of trunk and pelvis in supine position. Patient provides hip bridge and physiotherapists press laterolaterally the region of pelvis, rhythmically and patient tries to stabilise and keep a balance position of pelvis and trunk. In standing position tries with bent knees and externally rotated to keep the posture. Repeat 4-5 times.
7. Sensomotoric exercises (small foot), by Janda .Train 3 tect walking and distribute correct weight bearing in these points. In standing position patient tries to bring metatarsal bone close to heel and form a bridge. Then patient tries to move forward with this principle and backward. Repeat 6-7 times. Afterwards tries to bend slight front the whole trunk based on 3 points.
8. Walking along the corridor, improving muscle strength and power in lower extremities and correct.

Results:

Subjective:

She feels more confident while walking and better, fluent motion in hip joint (F, E, ABD, ADD) and ankle joint (PF, DF).

Objective:

Slight increase in ROM when repeating the movements in hip joint in the direction of F, E and ankle joints in the direction of PF and DF. While walking there is good activation of gluteus maximus mm. during extension of hip joint (both) and also in ankle joints in direction of PF and DF and correction of valgosity of Achilles tendon and ER of both knees. Also slight release of tension after the application of soft tissue techniques and increase of elasticity and extensibility on right thigh, calf (anterior side) in all directions (caudocranial, mediolateral)

Self therapy:

She can provide by herself actively flexion of hip joint along with flexion of knee joint (when flexing hip).Repeated 7-10 times. As well as E of hip joint ABD and ADD in standing position with support. Also TEP exercises and repeat 5 min each hour. Breathing exercises were instructed too. She was told to raise both arms, breathe deeply and release. Repeat 5-6 times daily. (Activate abdominal muscles and diaphragm)

*****Patient before leaving the hospital was instructed to take care of the scar by hydrating it and applying soft tissue techniques for releasing the tension. Also she was told not to provide deep sitting, but light with the support of her arms and keeping straight posture and neutral position of pelvis. Among the instructions was to try to put more of her weight when bending the knees and hip joints as in sitting, on these joints and not to increase pressure in lower back.

3.6 FINAL KINESIOLOGIC EXAMINATION

I. Observation
II. Postural examination
III. Palpation of pelvis
IV. Anthropometric examination
V. Muscle Tone Examination (palpation), by Lewit
VI. Soft tissue examination, by Lewit
VII. Gait examination
VIII. Movement patterns
IX. ROM examination, by Kendall
X. Muscle strength test, by Kendall
XI. Muscle length test, by Janda
XII. Joint play examination, by Lewit
XIII. Breathing examination
XIV. Neurological examination

I. Final Observation:

- **Oedema is slight decreased at the region of low back and at the region of scar.**
- **External rotation of the both lower extremities and slight abduction are more controlled.**
- **More expansion of rib cage and upper thorax while breathing.**

II. Final Postural examination:

POSTERIOR VIEW

• Slight valgosity of Achilles tendon on both sides
• Slight varosity of the right calf
• **Popliteal lines in external rotation of both knee joints is slight less**
• Slight higher gluteal line in the right side
• ASIP slight higher on the right side
• **Slight improved lateral flexion of trunk to the left side**
• Trunk bends slight forward
• Left shoulder slight higher
• Thoraco-axillar triangle slight bigger on the left side
• Left scapula slight abducted
• **Slight decreased lateral flexion of head to the right side**

Table 18- Final postural examination, posterior view

ANTERIOR VIEW

• **Semiflexion in left knee is even less, extension of the knee is present**
• **Weight bearing in 3 tect points**
• Slight hallux valgus on both feet
• Slight varosity of the right calf
• **Slight external rotation of both patella joints, but mostly seen on the right one is less**
• Hypertrophy of quadriceps m. in both legs
• ASIP slight higher on the left side
• Slight lateral flexion of trunk to the left side
• Right shoulder slight higher
• Thoraco-axillar triangle slight bigger on the right side

• Right clavicle slight higher on the right side
• **Slight decreased lateral flexion of head to the right side**

Table 19- Final postural examination, anterior view

LATERAL VIEW

RIGHT SIDE

• **Weight bearing in 3 tect points**
• Slight rotation of trunk to the right side
• Slight flexion in hip joint
• Hyperextension of the knee joint
• Slight anterior tilt of pelvis
• Slight kyphosis in thoracic spine (mostly seen in upper thoracic)
• Arms protracted
• Slight head forward

Table 20- Final postural examination, lateral view (right side)

LEFT SIDE

• **Weight bearing in 3 tect points**
• **Semiflexion in left knee is even less, extension of the knee is present Flexion of the hip joint**
• Slight rotation of trunk to the right side
• Slight anterior tilt of pelvis
• Slight kyphosis in thoracic spine (mostly seen in upper thoracic)
• Arms protracted
• Slight head forward

Table 21- Final postural examination, lateral view (left side)

III. Final Palpation of pelvis:

- Iliac crest: Slight higher on the right side.
- ASIS: Slight higher on the right side.
- PIIS & ASIS in transversal plane- right and left side: slight torsion to the left side.

*When lying ASIS are in the same line.

IV. Final Anthropometric Measurements

Lower extremities length

	Sinistra	Dexter
Functional length	94cm	95cm
Anatomical length	85cm	86cm
Thigh	47cm	48cm
Lower leg	37cm	38cm
Sole	22cm	22cm

Table 22- Final anthropometric measurements- length of LE

Lower extremities circumference

	Sinistra	**Dexter**
10cm above patella	42cm	43cm
15cm above patella	47cm	48cm
Lower leg	35cm	37cm
Waist	92cm	
Hips	90cm	

Table 23- Final anthropometric measurements- circumference of LE

V. Final Muscle Tone Examination (palpation), by Lewit

Tested muscle	**Sinistra**	**Dexter**
Rectus Femoris	Eutone	**Eutone**
Vastus medialis,intermedialis, lateralis	Eutone	**Eutone**
Adductors	Tension	**Eutone**
Iliopsoas	Tension	Hypertone
Piriformis	Tension	Hypertone
Tensor fasciae latae	Eutone	**Eutone**
Erector spinae (thoracic and lumbar part)	Hypertone	Hypertone
Gluteii	Tension	Tension
Hamstrings	Tension	Hypertone

Gastrocnemius	Tension	**Less tension**
Tibialis anterior	Tension	Tension
Abdominals (upper and lower)	Hypertension	Hypertension
Achilles tendon	Tension	Hypertension

Table 24- Final muscle tone examination (palpation), by Kendall

VI. Final Soft tissue examination, by Lewit

- Examination of skin and subskin in all directions (caudal, cranial, medial and lateral) of LE and back**: improved elasticity** in all directions more of the right thigh, calf.

- Examination of fasciae by wave technique of LE and back: **improved elasticity** more of right thigh, calf.

VII. Final Gait Examination

Wider base
Longer steps
Confident walking
Slight valgosity of Achilles tendon
Slight varosity of calf, more on the right side
Semiflexion in left knee is even less, extension of the knee is present
Slight external rotation of both patella joints, but mostly seen on the right one
More weight bearing on medial sides of feet and metatarsal heads and less on heels
Improved motion in DF and PF of right ankle joint
Trunk in more extension position
Less sstiffness of the trunk
Controlateral rotation of trunk and pelvis and motion of the arms, **better synkinesis**
More swinging motion in both upper extremities
Arms protracted
Slight head forward
Slight kyphosis in thoracic spine (mostly seen in upper thoracic)

Table 25- Final gait examination

*__After verticalisation she feels no vertigo.__

VIII. Final Movement patterns

Hip abduction (sidelying position):

- Tensor mechanism in both lower extremities.
- Secondary activation of gluteus medius in both sides.

Hip extension (prone position):

- First activation of contra lateral erector spinae (lumbar part) for both sides and right after gluteus maximus, **better quality of activation though of gluteus mm.**

IX. Final ROM examination, by Kendall

According to SFTR method

HIP JOINT				
Plane	**Sinistra**		**Dexter**	
	Active Movement	**Passive Movement**	**Active Movement**	**Passive Movement**
S	5 -0- 75	10 -0- 80	5 -0- **85**	**10** -0- **90**
S*	5 -0- 110	10 -0- 115	10 -0- **110**	15 -0- **115**
F	40 -0- 5	45 -0- 10	**40** -0- 5	**45**-0-10

Table 26- Final ROM examination (hip joint)

*With flexed knee.

KNEE JOINT				
Plane	**Sinistra**		**Dexter**	
	Active Movement	**Passive Movement**	**Active Movement**	**Passive Movement**
S	0 – 0 - 110	0 – 0 - 120	0 – 0 - **110**	0 – 0 –**120**

Table 27- Final ROM examination (knee joint)

ANKLE JOINT				
Plane	**Sinistra**		**Dexter**	
	Active Movement	**Passive Movement**	**Active Movement**	**Passive Movement**
S	30 -0- 10	35 -0- 20	**30** -0- **15**	**35** -0- **25**

Table 28- Final ROM examination (ankle joint)

*Scale according to Janda: 0- no shortness, 1-moderate shortness, 2- marked shortness.

X. Final Muscle Strength Test, by Kendall

Tested muscle	**Sinistra**	**Dexter**
Quadriceps Femoris	4+	4+
Adductors	**4+**	**4+**
Abductors	**4+**	**4+**
Gluteii	4+	**4+**
Tibialis anterior	4+	4
gastrocnemius	4+	**4+**
hamstrings	4+	**4+**

Table 29- Final muscle strength examination, by Kendall

XI. Final Muscle Length Test , by Janda

Tested muscle	**Sinistra**	**Dexter**
Hamstrings	1	1
Iliopsoas	1	1
Gastrocnemius	0	**0 (Improved)**
Soleus	0	**0(Improved)**
Rectus femoris	0	0
Tensor fasciae latae	0	0

Table 30- Final muscle length examination, by Janda

XII. Final Examination of joint play, by Lewit

JOINT	**Sinistra**	**Dexter**
Tibiofibular joint on rotation (IR-ER)	not restricted	not restricted
Tibiofibular joint on dorsal and ventral direction	not restricted	not restricted
Patellar on all directions (cranial, caudal, medial, lateral)	**improved** in caudocranial direction	**improved** in caudocranial direction
Interphalangeal joints of toes, in all the directions (dorsal, plantar and lateral side)	**Improved mobility**	**Improved mobility**
Metatarsophalangeal joints, in all the directions (dorsal, plantar and lateral side)	**Improved mobility**	**Improved mobility**
Calcaneus bone, in lateral and ventral	**Improved mobility**	**Improved mobility**

direction and circumduction		
Navicular bone, in dorsal and plantar direction	**Improved mobility**	**Improved mobility**
Cuboid bone, in dorsal and plantar direction	**Improved mobility**	**Improved mobility**
Taloclural joint in dorsal direction	no resistance is felt	no resistance is felt

Table 31- Final joint play examination, by Lewit

XIII. Final Breathing examination:

- **Better expansion of rib cage.**
- **Better activation of abdominal muscles and diaphragm.**
- **Improved breathing wave.**

XIV. Final Neurological examination:

Laseuge test:

- Negative for the left one. (only **stretching feeling at 90˚**)
- Negative for the right one. (only **stretching feeling at 90˚**)

Taxis for LE: Negative for both sides.

Superficial sensation

Dermatomes evaluation

	Sinistra	**Dexter**
Dermatomes of L5 segment	Asymmetry (hypesthesia)	No asymmetry
Dermatomes of S1 segment	Asymmetry (hypesthesia)	No asymmetry

Table 32- Final Neurological examination- dermatomes evaluation

Kinesthetic - ***Position sense***

	Sinistra	**Dexter**
Big toe	Normal response	Normal response
1^{st}-5^{th} toes	Normal response	Normal response

Table 33- Final Neurological examination- position test

Deep Tendon reflexes

Type of reflex	**Sinistra**	**Dexter**
Patella reflex L3-L4	2+	2+
Achilles reflex L5-S2	2+	1+
Medioplantar reflex	2+	1+

Table 34- Final Neurological examination, deep tendon reflex

Evaluation grades, according to Véle:

2+ = Normal

- **Special tests:**

Romberg I: Negative

Romberg II: Negative

Romberg III: Negative **(slight instability but better control of posture, not balancing back and forward).**

Trendelenburg test:

Left leg: Negative

Right leg: Negative **(slight shaking but she can hold it longer in this position,better control of pelvis).**

3.7 Evaluation of effect of the therapy

Patient was after spine surgery (microdiscectomy) for decompression of the nerve roots of L5-S1 after disc herniation and spondylolisthesis at these segments. The surgery took place on the 18th of January.

My first contact with the patient was one day after the operation, on the 19th of January and the physiotherapy treatment started right after in order to gain the best results for her.

Mrs J. was suffering from chronic low back pain so there were expected to be compensating mechanisms from nociception and generally muscle alterations with disturbed postural and breathing stereotype.

I visited the patient on the 19th of January and that day I provided the initial examinations in order to estimate the restrictions in muscle functioning and limitation of ROM.

There were motoric and sensoric deficits as expected in spesific dermatomes (L5-S1) and decreased reflexes response on the right lower extremity. (Achilles tendon and medioplantar reflex).

Among the findings were some hypertonus muscles, (quadriceps, adductors, iliopsoas, piriformis, gastrocnemius), weak muscles (quadriceps, adductors, abductors, gastrocnemius, tibialis anterior, hamstrings, glutei mm.) and short muscles (hamstrings,

iliopsoas, gastrocnemius, soleus.) and the aim was to improve these muscle disbalances and make them more effective and functional in a corrected postural pattern.

Breathing and postural pattern had to be corrected as well and improvement of proprioception for better coordination and control of the different positions. The fasciae and soft tissue were found less elastic and their mobility was affected, with restriction of the barrier (in right thigh- calf and increase elasticity)

The therapy was positive and the patient was in good mood was feeling better as the days were passing.

Through the therapeutic procedures that I had chosen, there was increase in ROM in hip joint in the direction of F, E and knee joint while trying to gain E and eliminate semiflexion. Also increase was noticed in ankle joint in direction of DF and PF. This was achieved in the model of active movements exercises in lying and standing position, and having them repeated several times so that to get the needed results.

Also strengthening of the weaker muscles and relaxation of the hypertonic muscles (as mentioned above) was important improvement as it helps for increasing in ROM in joints and being more functional in ADL. Shortened muscles also were stretched but there is still a range of gaining even more results.

Focus as well on the release and increase of the mobility of the fascia of right thigh-calf, thoracolumbar fasciae and increase elasticity. Improvement of the mobility of the scar, as a further step is also vital because if the patient is still feeling pain at that region it would be the reason for a secondary problem in her movement and mobility and alter other compensating problems.

The therapies that I provided helped my patient according to her postural and breathing background, influencing in this way also the gait pattern and correct any pathological stereotype.

She was very cooperative with me and we enjoyed the time together, being from her side satisfied.

It is crucial for the patient to continue with the exercises and the rehabilitation plan for the optimal results and being able to return back to her ADL, favorite habits and close to her family.

For prognosis I believe that she has the strength and will to work according to the guidelines of the physiotherapy plan at the rehabilitation department where she will be transferred, in order to achieve an improved musculature pattern with proper position of joints and muscle balance. Important for her is to return to her daily living activities and occupational facts following a correct pattern of standing, sitting, carrying, lifting and lifting fashion for providing the less possible strain and stress on joints.

4.

CONCLUSION

4. Conclusion

Patient during the whole sessions of the physiotherapy approach was very cooperative, friendly and was smiling all the time. She suffered for a long from low back pain and was treated ineffectively with a rehabilitation plan, including electrotherapy, mechanotherapy and hydrotherapy.

Surgery came as an urgent solution since an acute episode occurred, applying enormous forces and stress on the structures of lumbar region resulting in lumbar disc herniation and a slipped disc.

During the post-operative period and according to the instructions about the patient's physiotherapy program, it includes walking exercises from the very first day and light sitting from the second day. Transitional positioning (supine – prone and opposite) can be provided from the first day and patient has to move to induce the circulation and prevent TEP.

I met the patient on the second day after the operation date and established for her a suitable physiotherapeutic approach in order to relieve the post-operative pain and edema located low back region and gain the strength and power on her lower extremities and improve the stability of trunk. Also among the goals of the treatment was to increase as well as the lung capacity, and improve the breathing pattern affecting the postural background and further more enabling her to return back to her ADL.

My clinical practice during January took place at Ustředni Vojenská Nemocnice at the department of neurosurgery (spondylosurgery), under the experienced eye of my supervisor Mgr. Agnieszka Kaczmarská Ph.D.

I had a good time and I received it as a great experience. I enjoyed while working with the patients and offering them the best approach to their problem.

I worked fluently and with not any complications with my patient, taking advantage of my knowledge that I gained through the years of my studies at Charles University in Prague.

With patience and good willing my patient felt better after the therapies, walking was more confident, fluent, and less painful. Good activation of the muscles of trunk and lower extremities, with good stability and balance of her musculature apparatus.

She mentioned that during our last session she would leave afterwards, heading to the rehabilitation department in another clinic, for further physiotherapy sessions in more intensive rhythms. My opinion about her prognosis status is that she has the muscular power and the qualitative properties of the motoric strength that is needed to return back to her lifestyle frame and adopt daily living activities in her range of functional abilities and proportions. Important to achieve that results of course is to follow some instructions for proper sitting, standing and in general optimizing postural framework, with vital tips how to elevate foe example a burden from the ground to prevent further troubles with the spine.

5.

BIBLIOGRAPHY

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PUBLICATIONS

1. Agur A., Dalley A., Moore K., (2010), "*Clinically Oriented Anatomy"*, 6th edition. Published by Lippincott Williams & Wilkins, the Point. Philadelphia, USA. ISBN: 978-1-60547-652-0.

2. Bogduk N., (2012), "*Clinical and Radiological Anatomy of the Lumbar Spine"*, 5th edition, Published by Imprint: Churchill Livingstone, UK. ISBN: 978-0-7020-4342-0.

3. Bogduk N., (2005), "*Clinical Anatomy of the Lumbar Spine and Sacrum"*, 4th edition, Publisher: Churchill Livingstone, UK. ISBN: 0443101191.

4. Hamill J. & Knutzen K., (2008), "*Biomechanical basics of human movement"*, 3rd edition, Published by Lippincott & Williams Wilkins, USA. ISBN: 978-0-7817-9128-1.

5. Kendall F. et al, (2005), "*Muscles testing and function with posture and pain*", 5th edition. Published by Lippincott Williams & Wilkins. Baltimore, Philadelphia, USA. ISBN: 978-1-4511-0431-8.

6. Leveau B., (1977), "*Biomechanics of human motion"*, 2nd edition. Published by Williams & Lissner, W.B Company, USA. ISBN: 0-7216-5773-7.

7. Lewit K., (2007), *"Manipulative therapy in musculoskeletal medicine",* 1st edition. By Churchill Livingstone Elsevier, UK. ISBN: 9-780-7020-3056.

8. Netter F., (1997), "*Atlas of human anatomy",* 2nd edition. Published by Novartis publisher company, UK. ISBN: 978-0914168812.

9. Norris C., (2008), *"Back stability-Integrating science and therapy",* 2nd edition. Published by Human Kinetics. Oxford, UK. ISBN: 978-0-7360-7017-1.

10. Oliver J. & Middlediteh A., (1991),"*Functional Anatomy of the spine*", 1st edition. Published by Butterworth Heinemann, Elsevier LTD, UK. ISBN: 0-7506-0052-7.

11. Otahal S., Konvickova S., Denk F., Holub O., (2010), *"Spinal complexity and its biomechanical reflection"*. 1st edition. Published by the Czech society of biomechanics, Charles University in Prague. Prague Czech republic. ISBN: 978-80-7399-910-0.

12. Piek. J., (1998), "*Motor behavior & human skill. A multidisciplinary approach"*, 1st edition. Published by human kinetics, USA. ISBN: 0-88011-675-7.

13. Richard W., (2003), *"Encyclopedia of the Human Body",* 2nd edition. Published by Dorling Kindersley Limited, first published in 2002. ISBN: 1-4053-0526-6.

14. Sabotta J., (1997), "*Atlas of human anatomy",* 12th edition. Published by Williams & Wilkins publisher company, NY, USA. ISBN: 978-0683300475.

15. Zatsiorsky V., (2000), *"Kinetics of human motion",* 1st edition. Published by human kinetics, USA. ISBN: 0-7360-3778-0.

ELECTRONICAL SOURCES

16. Cele E., Johansson A.C., Filiz M., "*Disc herniation"* by Physio-pedia. In electronic form is available: *< http://www.physiopedia.com/Disc_Herniaton#cite_note-McGill-0>*. Updated on 6.2011. Retrieved on 4.2012.

17. Henry G., "*Anatomy of the Human Body"* by Bartley.com. In electronic form is available: *< http://www.bartleby.com/107/19.html >*. Updated on 5.2011. Retrieved on 3.2012.

18. Ullrich P. "*Vertebrae in the vertebral column"* by Spine-Health. In electronic form is available*: <http://www.spine-health.com/conditions/spine-anatomy/vertebrae-vertebral-column>*. Updated on 8.2009. Retrieved on 3.2012.

LECTURE NOTES

19. Holubarova, J. *Manual Methods in Physiotherapy, according to Lewit*. Prague, 2011. 81 s. Lectures notes. Charles Univeristy in Prague.

20. Jalovcova, M. *Basic Therapeutic Methods I: anthropometric measurements*. Prague, 2009. 10 s. Lectures notes. Charles Univeristy in Prague.

21. Jalovcova, M. *Basic Therapeutic Methods I: gait examination, dymanic posture examination*. Prague, 2009. 33 s. Lectures notes. Charles Univeristy in Prague.

22. Jalovcova, M. *Basic Therapeutic Methods I: musculoskeletal assessment*. Prague, 2009. 7 s. Lectures notes. Charles Univeristy in Prague.

23. Jalovcova, M. *Basic Therapeutic Methods I: postural examination*. Prague, 2009. 21 s. Lectures notes. Charles Univeristy in Prague.

24. Jalovcova, M. *Basic Therapeutic Methods II: evaluation of joint of motion*. Prague, 2010. 23 s. Lectures notes. Charles Univeristy in Prague.

25. Jalovcova, M. *Basic Therapeutic Methods II: muscle length test, according to Janda*. Prague, 2010. 8 s. Lectures notes. Charles Univeristy in Prague.

26. Jalovcova, M. *Basic Therapeutic Methods II: muscle strength test, according to Kendall*. Prague, 2010. 18 s. Lectures notes. Charles Univeristy in Prague.

27. Jalovcova, M. *Basic Therapeutic Methods III: palpation, changes of muscle tone, musculoskeletal dysfunction, according to Lewit*. Prague, 2010. 10 s. Lectures notes. Charles Univeristy in Prague.

28. Panek, D. *Basic Therapeutic Methods III: Neurological examination*. Prague, 2010. 74 s. Lectures notes. Charles Univeristy in Prague.

29. Véle F, *Clinical Kinesiology: Lumbar spine.* Prague, 2011. Lectures notes. Charles University in Prague.

6.
SUPPLEMENTS

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6.1 LIST OF PICTURES

6.2 LIST OF TABLES

6.3 **ABBREVIATIONS**

ABD - Abduction

ADD - Adduction

ADL - Activities of Daily Living

AF - Annulus Fibrosus

DF - Dorsal Flexion

E - Extension

ER - External Rotation

F - Flexion

IF - Interferential current

IP - Inter-Phalangeal joint

IR - Internal Rotation

IVD - Inter Vertebral Disc

IVJ - Inter Vertebral Joint

ITB - Ilio-Tibial Band

LE - Lower Extremities

MTP - Meta-Tarso-Phalangeal joint

NP - Nucleus Pulposus

PF - Plantar Flexion

PIR - Post Isometric Relaxation

ROM - Range Of Motion

SI - Sacro-Iliac joint

TEP - Thrombo Embolic Prevention

TFL - Tensor Fasciae Latae

UE - Upper Extremities

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Application for Ethics Board Review

of the undergraduate research

Project title: Case study: Physiotherapy treatment of patient with diagnosis of disc herniation and spondylolisthesis of L5-S1.

Nature of the research project: undergraduate research

Author: Anastasia Krokou

Supervisor: Mgr. Agniezka Kazsmarska Ph.D

Research project description:
Case study: Physiotherapy treatment of patient with diagnosis of **disc herniation and spondylolisthesis of L5-S1** will be conducted while being supervised by a professional and expert physiotherapist at **Ustredni Vojenska Nemocnice in Praha.**
No invasive methods will be used. Personal data obtained during the practice will not be published.
Draft informed consent (enclosed)

Date: Monday 23rd of January 2012 Author's signature:

Faculty of Physical Education and Sport, Charles University in Prague
ETHICS BOARD REVIEW

Ethics Board members: Doc. MUDr. Staša Bartůňková, CSc.
Prof. Ing. Václav Bunc, CSc.
Prof. PhDr. Pavel Slepička, DrSc.
Doc. MUDr. Jan Heller, CSc.

The Ethics Board at the Faculty of Physical Education and Sport, Charles University, approved the research project.
Approval number: 080/2012
Date: 1.2.2012

The Ethics Board at the Faculty of Physical Education and Sport, Charles University, reviewed the submitted research project and **found no contradictions with valid principles**, regulations and international guidelines for biomedical research involving human subjects.

The chief investigator of the project met the necessary requirements for receiving the Ethics Board approval.

Official school stamp

UNIVERZITA KARLOVA v Praze
Fakulta tělesné výchovy a sportu
José Martího 31, 162 52, Praha 6

Signature, REB Chairman

INFORMOVANÝ SOUHLAS

V souladu se Zákonem o péči o zdraví lidu (§ 23 odst. 2 zákona č.20/1966 Sb.) a Úmluvou o lidských právech a biomedicíně č. 96/2001, Vás žádám o souhlas k vyšetření a následné terapii. Dále Vás žádám o souhlas k nahlížení do Vaší dokumentace osobou získávající způsobilost k výkonu zdravotnického povolání v rámci praktické výuky a s uveřejněním výsledků terapie v rámci bakalářské práce na FTVS UK. Osobní data v této studii nebudou uvedena.

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Souhlasím s nahlížením níže jmenované osoby do mé dokumentace a s uveřejněním výsledků terapie v rámci studie.

Datum:……

Osoba, která provedla poučení:……

Podpis osoby, která provedla poučení:……

Vlastnoruční podpis pacienta /tky:…….